THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE STREET LIGHTING QUESTION.

OUR boastful enemy is again on the war-path. A monthly municipal contemporary, posing as an impartial publication, prints an article on "Gas *v.* Electricity," by a very pronounced gas advocate.

The subject matter is street lighting, and the pith is, of course, the threadbare "triumph" in the City. He complains that in London the judgment of the authorities is in some cases influenced by the fact that the electricity supply is in their hands. No doubt; and in many provincial towns where the gas undertaking is in the hands of the local authority there is a similar bias in favour of gas. It is an unfortunate fact that the good of the community is often sacrificed in order to show a false profit on municipal enterprise. When, however, the writer makes such obviously untenable statements as that the Islington arc lamps illuminate the streets no better than a number of paltry gas lamps, we can no longer join issue with him. Some considerable pains are taken to prove that the ideal street lighting is to be obtained by placing a number of small units fairly close together, and by a process of reasoning based on the effective illumination varying as the square of the distance, the writer appears to arrive at the conclusion that 350-C.P. high-pressure gas lamps, 12 ft. from the pavement and 24 yards apart, exactly meet the case.

But if small units, and many of them, are to be the order of the day, why use high-pressure lamps at all? Why not ordinary incandescent mantles, or batswing burners, or, better still, a series of 1-C.P. gas jets? Calculating on the basis of 350 C.P., 12 ft. high and 24 yards apart, we should arrive at a picturesque series of 1-C.P. lamps 8 in. high and 3 ft. 11 in. apart, *which is absurd!*

Clearly the whole matter hinges on the question of which is the more efficient in the long run: to use high candle-power lamps (which with gas, as well as electricity, are considerably more efficient than low candle-power ones) at a fair distance apart, and put up with the inevitable loss due to the necessity for hoisting them up in the air in order that their rays may be more or less uniformly distributed: or to use low candle-power lamps of lower efficiency, and save the loss referred to by being able to put them on shorter posts, owing to their being closer together. Practice proves that with both illuminants the higher candle-power lamps are so efficient as to more than make up for the loss due to their being placed high up. Hence the use of the high-pressure gas lamp and also of the arc lamp for public lighting.

A motor lamp lights the roadway perfectly, but leaves the upper strata pitchy dark by contrast. A broad street with high buildings requires large units at a considerable height. Narrow streets with squalid buildings are better served with comparatively short posts, and consequently much lower candle-power lamps suffice. Now the particular candle-power, height and spacing is clearly dependent on the nature of the thoroughfare, and no hard and fast rule can be made which will justify the use of lamps of 350 or any other definite candle-power.

The reason why a broad street is better lit by arc lamps than by any other known source of light—and no amount of literary effort on the part of our gas brethren can discount this statement, which is obvious to any impartial observer—

is the fact that the greater part of the light is thrown downwards at an angle from a considerable height, and is, therefore, more diffused than if it came from a large number of small sources at a height nearer the level of the eyes. In other words, the former is a nearer approximation than the latter to daylight, which is a perfectly diffused light coming from one huge source. A small number of high candle-power lamps are cheaper to run than a large number of low candle-power ones, and no one knows that better than the advocates of gas; if they could produce a light as good as an arc lamp, the gas people would soon change their tactics. Indeed, it is not surprising that the flame arc lamp "is beginning to offend the eye and irritate the nerves" of the writer in question, whose references to the Gas Light and Coke Co. suggest an intimate connection with that enterprising, if misinformed concern.

The writer goes into the relative costs of high pressure gas lamps and arc lamps, and in doing so he does what has once been said of a well-known lady novelist; he sets up an Aunt Sally of his own manufacture, and then amuses himself by shying at it. He lays down the law that 90 gas lamps, which he estimates at 350 c.p. apiece, will light a mile of street at least as well as 60 arc lamps, each of which he is generous enough to credit with 700 c.p. He goes through a series of carefully constructed figures, which terminate in the conclusion that the arcs are nearly twice as costly as the gas lamps. He does not mention whether his mantles are all brand new in order to give him 350 c.p. His comparison with flame arcs is not quite so successful. These, he admits, give 1,200 c.p., so he only takes 40 of them, with 8 amperes instead of 10, as in the case of the ordinary arcs. At the end of the juggling, gas is made to cost £660, and electricity £880. It is not difficult to see that with the bias on the other side, these figures would be reversed. In passing, it may be mentioned that at a later stage in the article the writer points out the unreliability of comparative tests of candle-power made in the streets. What a pity he based his figures on candle-power! He half admits that these considerations are theoretical, so he next proceeds to what he calls the practical side of the question. He mentions nine metropolitan districts out of twelve which do not possess an electric supply undertaking, where there is no electric street lighting. He next cites Liverpool and Bradford, the former possessing some hundreds of arc lamps, and the latter admittedly one of the worst lit towns in the kingdom, also the City of London—but we know all about that—and Westminster, as cases of gas being preferred to electricity. Here is a little list to set against his. It is a list of towns where both the gas and electric light undertakings are owned by private companies, and where gas has been replaced by electricity for public lighting in all or nearly all the streets:—High Barnet, Bournemouth, Brechin, Callow, Chelmsford, Dartmouth, Fleetwood, Frome, Godalming, Hawick, Hythe, Lymington, Melton Mowbray, Montrose, Newton Abbot, Prescot, Redruth, Sandown, Ventnor, Wellingborough, Windsor, and High Wycombe. Also Blaenau Festiniog and Llan Festiniog, *where the gas is owned by the local authority*. Let our gas friends put that in their pipe and smoke it. Then let them read the following list of some of the towns where both illuminants are supplied by the local authority, and where gas has either been entirely supplanted by our illuminant, or arc lamps installed in all the more important thoroughfares:—Aberdeen, Accrington, Barrow-in-Furness, Batley, Birkenhead, Blackburn, Blackpool, Darwen, Edinburgh, Glasgow, Morecambe, Leeds, Nottingham, Paisley, Partick, Perth, Salford, Southport, Wallasey, and West Bromwich. Now, who has the best of the practical side of the question?

We admire the enterprise of our rivals in scattering statements broadcast which are intended to mislead the public into believing that electricity is no longer the best street illuminant. But their arguments will not wash. You may talk about candle-powers till all is blue, but if you take a man along two streets, one lit by the best arc lamps, and the other by the best gas lamps, there is no question but that he will tell you that the latter is not to be compared to the former. Money may be saved by lowering the standard of street illumination, but to do so it is not necessary to use gas. There are many varieties of electric lamps on the market which can compete successfully in price with the corresponding gas lamp.

We cannot close these remarks without saying a few words about the interview with Mr. Morton, the chairman of the Streets Committee of the City of London. Here are one or two of Mr. Morton's statements as examples of his *lack* of bias:—"Apart from any question of cost, I think we cannot obtain as efficient a light from any description of electric arc lamp as from incandescent gas lamps." Referring to the City arc lamps, he says, "We are getting quite four times the amount of light for the same money or less." Referring to the burning of arcs and gas lamps side by side in Monument Street, he says, "Practically all the light was coming from the gas lamps." Comment is superfluous.

In regard to side street lighting, the writer admits the rivalry of the Nernst lamp with the incandescent gas lamp. He compares a 90-c.p. gas mantle with a ½-ampere Nernst, and calculates the energy consumption of the latter at £3 7s. 6d. per annum for 4,000 hours' burning, with energy at 1½d. per unit. In the first place, his figure for the Nernst lamp is inaccurate, and in the second place, we do not remember having seen a Welsbach burner of 90 c.p. This article, *immediately after erection*, is usually credited with from 50 to 60 c.p., and its consumption is given as about 4 cb. ft. per hour. Hence we may assume that the hypothetical 90-c.p. mantle takes at least 6 cb. ft. per hour. With these corrections the figures will tell quite another story. As a matter of fact, the average price charged for gas lighting throughout the country on a 4,000-hour basis is about £3 12s. 6d., and there are many places where Nernst lighting is done for less than £3 per lamp per annum.

Unfair Advertisement.

It is a scandal of common knowledge that large numbers of municipal appointments are publicly advertised as vacant and usually six or even nine candidates are interviewed, when all the time the appointment of the *successful* candidate is a foregone conclusion. If this advertising is done simply to blind the eyes of the ratepayers, who are thus led to believe that care is being exercised, then it is a very mean form of hypocritical lying. If such advertisement is compulsory by law, then it is time the law was amended.

An advertisement may be replied to even by hundreds of candidates. The minimum cost of a serious application cannot usually be less than ten shillings, for municipal committees are credited with refusing to look at written applications or copies of testimonials. Now all these fifty or more applicants are put to an expense which many of them cannot afford, in order to cover the doings of a committee which is either ashamed of its foregone conclusion or too wilfully stupid to let it be known. No one can say that the assistant engineer in a place should not be given the chief's place when this falls vacant. Often the assistant is as good a man as can be found for the place, and often he has honestly earned it. Why, then, should his appointment, or the appointment of any other selected candidate, be made the occasion of levying a heavy fine in time and money upon a crowd of applicants, for a post to secure which they ought never to be led to expect? Where the man for the appointment has already been decided upon, it does, of course, frequently happen that much better men make application, and it may be observed that, in such cases, the members of the interviewing committee have an extremely bored air, and cannot be accused of an excess of politeness to candidates, many of whom are men of better education and higher ability than the committee, and ought not to be subjected to such indignities from the ratepayers' *representatives*. It is high time that this method of doing business was altered, both in fairness to candidates and in the interest of public morals, for such empty advertisements are grossly immoral, no matter how good may be the man selected beforehand. We make no reference to any single municipality; it seems to be a common failing of such bodies.

The Electrical Production and Distribution of Music.

The electrical engineer with imagination or soul never loses the feeling of awe at the wonders accomplished by electricity, notwithstanding the fact that he is daily handling electrical apparatus. It is perhaps because he knows something of the various processes and agencies which are called into operation in order to perform the simplest of electrical functions. We are so accustomed nowadays to ringing up the exchange and speaking to one another across distances, that we have come to treat it almost as a commonplace which contains in it nothing of the mysterious or the marvellous. The storage and reproduction of sounds either of the human voice, the cries of animals, or of instrumental music, was regarded as impossible until the invention of the phonograph; now it ranks among the commonplaces. Notwithstanding, however, all the advances made in telephony, and the improvements made in the details of the phonograph and gramophone, the transmission and reproduction of sound, either of the voice or of music, cannot even yet be looked upon as entirely successful. There is always something wanting in the reproduced sounds, which lack the individuality and character of the sounds originally produced. In the case of the transmission of music by electrophone, the above disadvantages are due to the fact that, to obtain the best results, the telephone receiver must be held close to the ear; and also to the limitations of the microphonic effect. Whilst the microphone is able to magnify minute sounds, this magnifying effect falls off as the intensity of the original sound increases, and this then tends to flatten out the variations of intensity into a monotonous and mechanical level.

If we are to credit a description given by our contemporary the *Electrical World* of New York—and there is no reason why we should not, as we have almost ceased to doubt the possibilities of electricity—an entirely new and most satisfactory method of producing and distributing sounds has been invented and developed by Dr. Cahill. In this system, no sound is produced except at the receiving end, the generation and transmission being, as in the case of transmission by telephone, by electrical vibrations only, differing, however, from the telephone in that no sound is put into the transmitting end. In the case of a telephone, some half-dozen or so transmissions have to be gone through between the receiver and the original transmitter. There are the vocal chords in the case of speech; reeds, strings or pipes in the case of instrumental music; then the sound waves must be transmitted to the receiver, these giving rise to electrical vibrations, which are magnified by the microphone, then transformed by induction coil, transformed again at the receiving end by means of magnetic agency into vibrations of a diaphragm, which again give rise to the sound waves. These various transformations have the effect of distorting the wave shape, which seriously injures the musical character and beauty of the sounds.

In Dr. Cahill's system of music transmission a battery of alternators of different frequencies is used. These alternators answer to the strings or reeds or other vibrators of musical instruments. The method of operation is by means of a piano keyboard, the keys of which operate switches, which bring the several or individual alternators into action. The alternators are of the inductor pattern, the fixed stator carrying both field and armature windings. The rotors are mounted upon shafts which are geared together, and the number of poles and the angular velocities in the several rotors are so arranged as to produce notes ranging through five octaves. The tuning is said to be remarkably good and absolutely unchangeable. A number of expression devices actuated by the touch of the performer enable him to put character and individuality into the music played. The depression of a key closes a ground tone circuit and one or more other circuits corresponding to harmonics of that ground tone. A mere ground tone produces a clear pure flute note; the addition of the third and fourth harmonics of suitable strength produces the sound of a clarinet, whilst all the harmonics up to the eighth are necessary in order to imitate the violin. Another combination of the harmonics in which the seventh and eighth are strong, gives the characteristic blare of brass. A skilful performer can, besides reproducing the leading orchestral notes or tones, so mix the harmonics as to produce musical timbres hitherto unknown. It is said further that the musicians at the Cahill Laboratory can produce very good vibrato effects and crescendos and diminuendos not inferior to those produced by a good violin. In order to produce highly composite vibrations, say, for example, to represent the violin, 'cello, clarinet and flute, &c., at the same instant, an apparatus called a "tone-mixer" is used. Tone-mixers are special forms of inductoriums having many primary circuits into which the different vibrations are fed, the resultant vibration in the secondary circuit being equivalent musically and electrically to the several series of vibrations in the primary circuits. By this means it is possible to produce an effect at any point or distance as if an orchestra were really on the spot.

The receiving telephone is provided with a large paper horn, the net result of the system being that, instead of the feeble vibrations of the air acting upon a microphone, the performer is able to bring to bear upon the line the full power of a large alternator or a group of alternators. The wave distortions which may be produced in the line or apparatus are not of great consequence, as the performer hears what the listener hears, and can therefore set his stops or press the keys so as to produce the result which the ear demands.

All this sounds more or less like a fairy tale, but our contemporary, the *Electrical World*, reproduces illustrations showing the apparatus, some of which look particularly unmusical. The tone-mixing transformer, for instance, with a typical American mechanic in overalls standing alongside it, reminds one more of a boiler and stoker than a musical instrument or apparatus. The remarkable part of the whole arrangement is that, although the music of a whole orchestra can be produced, there is no musical instrument, as we commonly understand the term, used at all, the vibrations being initiated and transmitted by electrical means only.

The plant at the Cahill Laboratory is said to weigh nearly 200 tons, and has cost approximately $200,000. It is proposed to connect up hotels, restaurants, theatres and private houses with the laboratory, so that music will always be laid on. The resident can therefore attend an orchestral concert in his own home in the evening, and later on can be lulled to sleep by some soothing slumber music.

White Walls in a Photometer Room.

Mr. E. P. Hyde, in No. 3 Bulletin of the Bureau of Standards, U.S.A., deals with the question of the error produced in photometric work if the walls of the photometer room are whitened instead of being painted with the time-honoured dead black, and finds from exhaustive experiments that, with suitable precautions, the error produced is quite negligible. In all open-flame work the errors introduced by the poor ventilation of the average photometer room far exceed any errors arising from whitened walls, if suitable screening diaphragms are used with the latter.

The tests were carried out in the photometer room of the Bureau of Standards, the windows being covered with heavy curtains, and a series of black velvet diaphragms arranged so that at the Lummer-Brodhun photometer it was only possible to see the lamp under test, or the comparison lamp, against which first the standard lamp, then the lamp under test, and finally the standard lamp is again balanced; this substitution method eliminates all dissymmetry on the two sides of the photometer, and avoids the need of reversal of the photometer screen.

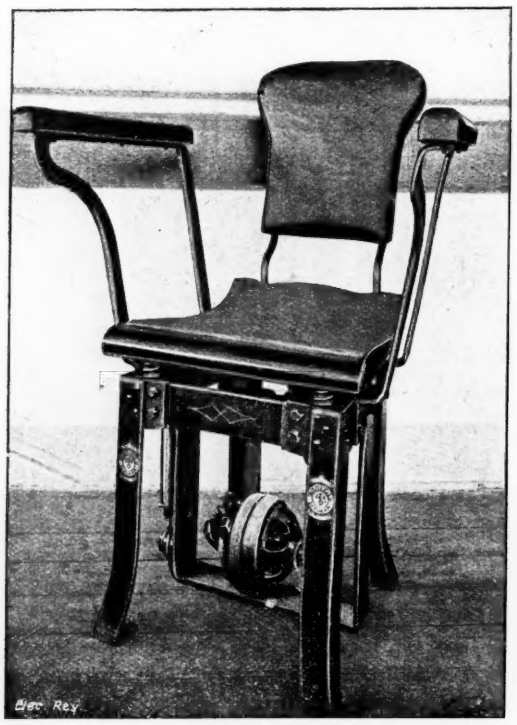
The results show that in this particular photometer room the errors introduced by light reflected from the white walls are of the order 1 part in 10,000, and are, therefore, quite negligible: even with the curtains removed from the windows the results of comparative tests would not be vitiated, but for absolute work it is desirable to use the curtains.

On the whole, the results now obtained show that with suitable diaphragms and screens, many rooms hitherto deemed wholly unsuitable may be used with success as photometer rooms.

A NOVEL APPARATUS FOR PREVENTING SEA-SICKNESS.

An interesting apparatus for preventing sea-sickness has recently been tried, with excellent results, on the steamship *Patricia* of the Hamburg-America line and the channel steamer *Peregrine*. Its operation is based on a vibrating motion which actually prevents the outbreak of the sickness, and the outfit is of the greatest simplicity, consisting merely of a comfortable chair, the seat of which is set rapidly vibrating up and down by means of an electromotor connected to the electric lighting mains of the steamer. Those wishing to protect themselves against the dreaded sickness sit down on the vibrating chair, when they feel about the same sensation as in riding on an automobile. The vibratory motion makes the rolling and pitching of the ship (which, as is well known, is responsible for sea-sickness) less felt, the slow downward motion of the ship being neutralised by the numerous short vibratory shocks occurring in an upward direction.

The success obtained with this apparatus (which was invented by Messrs. R. and W. Otto, directors of the Sanitas



Vibrating Chair.

Electric Co., of Berlin) on board the *Peregrine* and on the *Patricia*, on her last trip from Hamburg to New York and back, was quite surprising. As soon as the passengers felt the approach of the sickness, they sat down on one of the vibratory chairs, when any uneasiness was removed either immediately or after a short stay on the chair. Most of the patients remained free from illness throughout the journey, even after leaving the chair, while in some other cases the sickness returned a few hours after leaving the chair, to disappear and finally to be entirely removed after another treatment. In a third series of cases (which were the fewest in number, and mainly comprised extremely susceptible persons) the characteristic phenomena of sea-sickness, after having been kept away during the stay on the vibrating chair, would immediately return on leaving the latter. These passengers accordingly remained for hours (in some cases up to 10 hours) on the chair; but even in the case of so prolonged a treatment no injurious effect was observed. Everybody rather agreed on the agreeable effects of a stay on the chair, and many even took their meals there. Not a single case of vomiting while on the chair was recorded.

The writer is indebted for the above particulars to one of the inventors who, after never being free from seasickness in crossing the Channel about ten times, did not experience the least uneasiness on his recent journey, even in stormy weather, when testing his vibratory chair. The latter thus seems at last to afford the long-sought for remedy against this dreaded illness, enabling the passengers of a ship to derive all possible benefit from a sea voyage, without the hitherto unavoidable inconveniencies. The much-discussed idea of floating sanatoria will now be susceptible of realisation.

While being mainly a means of preventing the illness, the new apparatus has been found efficient also in some cases of advanced seasickness. The interest of medical circles has been aroused by the apparatus and scientific records of the observations made in connection with the same are shortly to be published in medical journals, by the doctors on board the steamers above mentioned.

It may be mentioned that the apparatus has been patented in all countries. A.G.

THE PROTECTION OF OVERHEAD EQUIPMENT.

No engineer familiar with the manner of erection of overhead tramway equipment, can suppress something of a smile when he reflects on the careful choice of galvanised span wire and the manner in which such wire is treated during the process of nozzling or fixing of the wire round the horse-collars or thimbles in the formation of an eye. The wireman employs a pair of rough jaw pliers, and he gives a final smoothing finish by gripping the freshly nozzled wire and giving it a few circumferential wrenches under a hard grip. Especially with hard wire, but to a great extent with all stranded wire, this rough treatment very effectually removes the zinc protection.

At one time—for, perhaps, the sake of appearance—some engineers made the mistake of using a span-wire of German make of hard, polished steel, to which the galvanising had a very weak adherence; in fact, the zinc flaked off the wires simply by bending round the thimble, and the rough usage of the wiremen's nippers took off much more of the coating than they did from softer wires.

In the absence of statistics and particulars as to the endurance of eyes so made, it is not possible to avoid the conclusion that this stripping must have reduced the durability of the wire nearly to that of bare wires. Otherwise it is not very obvious why galvanising need be resorted to. It has been suggested that a bath of molten zinc should be carried on the tower wagon, so that each eye as completed might be dipped, but considerations of safety preclude this. It ought not, however, to be a matter of great difficulty so to arrange matters that the span wires could be measured for on the poles and both ends nozzled in the workshop and each wire numbered for its respective place. The nozzles could then be treated by the Sherardising process of galvanising, which consists simply in burying the parts to be coated in a mass of zinc powder and heating to 500° F., a safe temperature that will not damage the wire. Any faults which have been made in the original zinc coating of the wires will be thus made good, nor should it be a matter of serious difficulty to keep the generally unhurt length of plain wire out of the influence of the zinc, nor to arrange a suitable portable furnace for use on a contract.

The Sherardising process is said to give a good and satisfactory even coating of zinc, and no trouble would be experienced from the possible oily state of the wire to be treated. The only difference from present practice is that the amount of stress put upon the poles would be allowed for at a fixed amount in the measurement, whereas at present the wireman puts on the stress by a pair of blocks and nozzles the wire to the stressed poles.

Poles are so alike in the amount they will spring, that this need not make much difference, especially now that overhead span wires are not put up taut, like harp strings, as they once were. Indeed, a taut span wire is detrimental to the

running of the trolley, because the spring of the poles helps to lift the trolley wire as the upward pressure of the wheel comes under the hanger. With an easy span wire the running of the trolley is softer. An advantage of the Sherardising system of dry galvanising is that parts in contact are not likely to be soldered together, for the deposit of zinc has no connecting or soldering action, and a chain put through the process would come out with all its links loose. Moreover, there is no need of wiping off any excess of zinc, for the thickness of the coating is measured by the allowance of time in the oven during which the material is exposed to the zinc.

The damaged ends of overhead wires seem to be a very suitable object for treatment. Indeed, it may be worth while for the tramway engineer to consider how far he can go in the direction of periodical treatment of his overhead equipment. Were poles always an exact distance apart, the matter would be very simple if the span wires were changed in lots of 50 by the use of 50 spare wires; but the uneven widths of roads and the inaccuracy of cross spacing of poles seem to preclude such methods, unless by the provision of a complete set of spare span wires. If an existing set of wires could be thus regalvanised before being unduly weakened by corrosion the matter would be accomplished, and at a cost certainly less than the provision of new wires, for every set of new wires involves as much labour *plus* the cost of the end nozzling, as the taking down and replacement of old wires by the spare set. A double set of wires ought to pay for itself. The old wires would be shackled to a continuous length, passed through suitable brushes, and cleaned by approved means, and regalvanised in a coiled state to await their turn for duty. Once a double set of wires was in hand, the changing of odd wires, as this appeared necessary, would be carried out as now.

In any new undertaking it would probably pay to make two wires for each span, so that there would be a spare set from the start, and there would never be any need for a wire to become seriously corroded.

A spare set of wires would absorb, perhaps, half a mile of wire per mile of route, and the interest on this and on the labour of making up the eyes would really be all the cost charges to lay against the economy of labour and wire throughout the whole life of the line. Every worn-out set of wires on the old system represents about half a mile of wire plus the cost of galvanising it plus the labour of nozzling and adjusting in place. There would be no expense of new wire under the new system, but merely the cost of regalvanising—sometimes perhaps only the ends—at less frequent intervals than the present renewal intervals of initially damaged and stripped wires.

B.

THE ELECTRICAL EXHIBITION AT NEWCASTLE-UPON-TYNE.

There was opened on Saturday last in the largest hall in Newcastle-upon-Tyne an electrical exhibition which is to run for four weeks, and which must prove of immense interest in a district so largely engaged in electric supply, and, if we may use a hackneyed phrase, so pregnant with vast opportunities electrically. The exhibition has been arranged by the local supply and lighting companies and electrical contractors. It is designed to show the many and varied uses to which electricity is now put both as an illuminant and as a motive power. Every piece of machinery in the exhibition is electrically driven, and, wherever practicable, the plant is in motion, thus affording a means of instruction to the electrician himself, but more particularly to the less-informed consumer. Altogether there are 180 stands, and 50 firms are displaying the most interesting examples of their manufactures. The exhibition hall, needless to say, is brilliantly lighted, and disappearing and changing coloured advertising signs are to be seen on every hand, while the general air of enchantment is enhanced by the music of famous bands, which have been engaged as additional attractions.

A most effective display is shown by the makers of and agents for lamps. The application of electricity to the lighting of shops and houses is shown by model shop windows, and by sitting-rooms and conservatories lit by reflected lights, and warmed by electrical radiators. Ingenious adaptations of electricity are to be seen in circular barbers' brushes, boot-blacking machines, laundry irons, washing machines, pumps, coal-cutters, whitewash-spraying machines, &c. Lifts large and small may be seen in operation. Electric travelling cranes of large capacity, and ship-lighting sets and motors of various designs are also prominently displayed. The productive processes may be fully seen, for here the process of manufacture of electricity from the coal pile to the incandescent filament through the medium of boiler, generator, cables, and the house fittings may be grasped by the most uninitiated. An object of interest is an uncovered Parsons turbine. Motor construction is demonstrated by a display of unassembled parts, and all branches of electrical activity may be seen contributing directly to general welfare. Chief among the exhibitors are the large power and lighting supply companies of Tyneside, such as the Newcastle-upon-Tyne Electric Supply Co., Ltd., the County of Durham Electrical Power Distribution Co., Ltd., the Newcastle and District Electric Lighting Co., Ltd., while among the makers and agents for electrical plants who are showing are Messrs. Crosier Stephens & Co., of Newcastle, Messrs. Falconer, Cross & Co., Newcastle, Messrs. T. G. Usher & Co., Newcastle, Messrs. J. H. Holmes & Co., Newcastle, Messrs. Robson & Coleman, Newcastle, and many other firms in Newcastle and other towns. To some of these exhibits we may refer in a later issue.

The exhibition was opened by Sir Isambard Owen, Principal of the Armstrong College, Newcastle-on-Tyne. Prof. Thornton, Principal of the Electrical Engineering Department at the same Institution, was in the chair, and he was supported by a large number of gentlemen prominently connected with electrical science and enterprise in the district. Sir Isambard Owen made some interesting statements in the course of his opening address. He pointed out that an exhibition of this kind was of peculiar importance to Tyneside—of more importance to Tyneside perhaps than to any other part of the United Kingdom. They had in that district the largest number of consumers of electricity per head of the population of any part of His Majesty's dominions, perhaps he might say of any part of the world. They had heard lately that a great chemical industry was about to be established on the banks of the Tyne. If that was the case the demand for electrical power would be precisely doubled. He added that electrical power could be produced on Tyneside at as low a rate as at the falls of Niagara. It was a pleasing coincidence that he was opening that exhibition just at the time when they had established a Chair of Electrical Engineering at the Armstrong College.

NATIONAL ELECTRICAL MANUFACTURERS' ASSOCIATION.

Annual Report and Meeting.

The annual meeting of this Association took place at the Hotel Cecil on Tuesday last week, and an official report of the proceedings has been sent to us.

The report of the committee for the year 1905, which was submitted for adoption, opened with a complaint that the facilities offered by the Association for bringing into closer contact the various branches of the electrical industry are not taken advantage of as frequently and as fully as would be desirable. Questions of policy of vital interest to the trade are stated to have failed from sheer lack of concerted action. Members are urged to take advantage of the facilities afforded for consultation together, and for the candid discussion of matters as they arise. Many of the points touched upon in the report are necessarily matters of common knowledge, which had received publicity in our records of the Association's doings on different occasions during the year. The advances in prices are quoted as among the benefits resulting from concerted action, and they were carried through without friction. The Olympian Electrical Exhibition was a success from all points of view, and therefore it was decided not to take any part

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case of vomiting while on the chair was recorded.

in other exhibitions during 1905 and 1906, save under now well-known conditions. A fire insurance expert has been appointed who gives his services free gratis for nothing, and under such terms those services have, of course, been availed of by members, and with considerable advantage. A Benevolent Fund for the electrical trades was started, and when the Exhibition surplus is placed to it that fund will be in a sound position, but further help is still asked for. Christmas-box and beanfeast circulars were issued, meetings of accumulator manufacturers and conduit manufacturers were called and held, Mr. C. S. Northcote was appointed as the Association's second representative on the Engineering Standards Committee, and by arrangement with the Commissioners of the Milan Exhibition, members of the Association are enabled to send exhibits on loan, free of expense, to be displayed at Milan during the next few months. The finances of the Association show a credit balance of £34 odd on a year of exceptionally heavy expenditure, and there is £100 invested in consols for whatever purpose it may be required for. The necessity for elaborating a scheme for obtaining information respecting the financial status of customers was referred to, and was put down to be discussed at the meeting. The number of members in the Association is 52.

At the annual meeting according to the official account received, Mr. C. S. Northcote, M.I.E.E, was voted to the chair, and in moving the adoption of the above report he generally reviewed the work of the Committee. As deputy-chairman of the Executive Committee of the Olympia Electrical Exhibition, he reported that the accounts of that Exhibition had been wound up, the financial result after returning to the exhibitors 25 per cent. of the amounts paid by them for space, showing a net profit of £1,515 7s. 10d. Of this sum £350 had been donated to the Benevolent Fund of the Institution of Electrical Engineers (instead of £250 as previously announced) and £650 to the Electrical Trades' Benevolent Institution under the auspices of their own Association, the balance, £515 7s. 10d., to be invested in the name of trustees (one of which was himself, as representing their Association) to form the nucleus of a fund for another Electrical Exhibition, to be held in London within five years and with the patronage of the Institution of Electrical Engineers. Failing these conditions, the sum is to be divided between the two Benevolent Institutions before mentioned in the same proportions as the amount already donated.

Mr. H. Oppenheimer (International Electrical Co.) in seconding the adoption of the report, invited criticism from the general body of members as to the actions of the Committee, pointing out that the Committee could only become more efficient in proportion as it received the active interest and support of the members. He also hoped that the members in future would be less reticent in availing themselves of the facilities afforded by their Association.

A general discussion then ensued, a feeling being expressed that the Executive Committee of the Electrical Exhibition should have consulted the exhibitors as to the disposal of the surplus funds. This view, however, did not meet with the support of the meeting, the general opinion being that the Executive Committee had exercised a wide discretion. Mr. L. M. Waterhouse (Simplex Steel Conduit Co.) reported as to the meetings of the conduit makers and an interview they had had with the Engineering Standards Committee. The Standards Committee were now in possession of their views, and he thought the result of their labours would be beneficial to the industry. Several members evidenced the advantage they had derived from the services of the insurance expert appointed by the Association. The question of trade credits was discussed, and a general instruction given to the committee to draw up a scheme to be presented to the members if possible within two months.

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The committee closed with a vote of thanks to the Chairman and secretary.

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"Power" writes:—"We should be obliged if you will let us have a reply to the following. We may say we have seen this matter raised in the Review before, but unfortunately we are unable to lay our hands upon the particular issue. If you can enlighten us on the following points we shall be glad:—

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The only difficulty likely to occur is that which may arise owing to the necessity of carrying cables across highways. Where, however, the soil of a highway or street is vested in the landowners on either side, and the consent of these parties can be obtained, such wires may be suspended, so long as they are placed so high as to be out of the way of passing traffic. In some cases it is competent for the local authority, in their capacity as highway authority, to object altogether to the suspension of such cables; but this is only in the rare instances where the soil of the road is vested in the authority. Again, in districts where the Public Health Acts Amendment Act, 1890, has been adopted, urban authorities have power to make by-laws for the prevention of danger or obstruction to the public from posts, wires, &c., placed in, over, or along any street. A form of by-laws has been approved by the Board of Trade. A copy of these by-laws can probably be procured from the Board of Trade or the King's printers. Further, the Board of Trade have published certain Regulations under Sec. 4 of the Electric Lighting Act, 1888, a copy of which should be procured from Messrs. Eyre & Spottiswoode, London, E.C., and studied by "Power" before they embark upon their enterprise.

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PROCEEDINGS OF INSTITUTIONS.

Idle Currents.

By M. B. Field (Member.)

(*Abstract of Paper read before the* Institution of Electrical Engineers *at Manchester, February 13th*, 1906.)

The characteristic of every form of idle current here dealt with is that, while constituting a part of the *total* current flowing in the circuit, it may be considered, conventionally, as an altogether separate entity superposed upon the real useful current, and be treated as such.

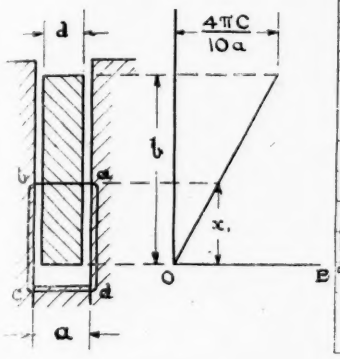


Fig. 1.

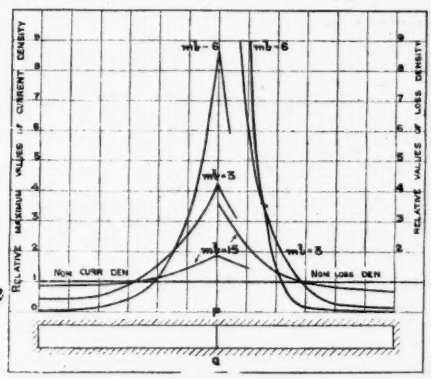


Fig. 2.

The idle current present when the power factor is not unity, frequently circulates throughout the entire circuit, and in such cases generators, mains, transformers, and other gear must be constructed with ampler proportions accordingly. The two main causes of the defective power factor are:—(*a*) Inductance in the load, as, for instance, when induction motors are largely employed; (*b*) capacity in the overhead lines or cables.

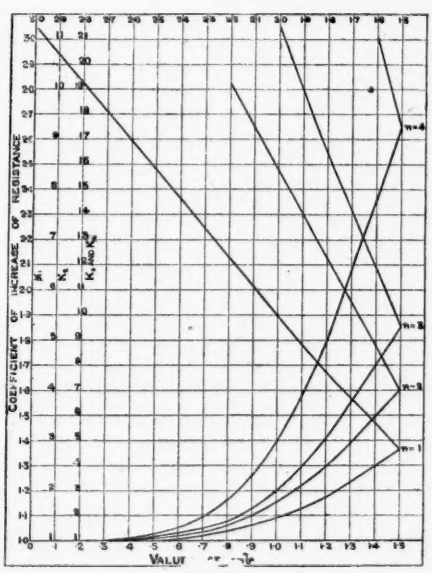
The only effective remedy in the first case, where the matter reaches serious proportions, is to run over-excited synchronous motors at the load end of the line. The calculation of the capacity of synchronous motors for the above purpose, in any specific case, is a matter of great simplicity, and need not concern us here.

The second instance enumerated above of defective power factor due to line capacity, only assumes serious proportions in the case of very long transmission lines at very high voltages. Suppose, for example, we consider a three-phase transmission line, 100 miles long, working at 80,000 volts, 25 cycles, the lines being 00 B. and S. arranged Δ-fashion 36 in. apart, and at an average of 30 ft. above the ground. It is a simple problem in electrostatics to calculate the current flowing into the line due to capacity effects. It works out approximately at 18 amperes per phase, or about 2,500 apparent kw. It will at once be seen that such an enormous apparent load for each set of three line wires would be a most serious item for the generating station to deal with.

The General Electric Co., of Schenectady, have manufactured reactances for voltages as high as 60,000 and for 2,500 apparent kw., for the purpose of relieving the generating station of the relatively enormous idle currents which are met with in such cases. It will, however, be observed that the use of synchronous motors and reactances does not cure the evil, but only mitigates it. In the first case the line and generators are relieved of the idle current, if the synchronous motors be situated at the far end, *i.e.*, the idle current is restricted to the environs of the load, circulating between the over-excited synchronous motors and the induction or other motors which constitute the load.

In the second case the generating machinery is relieved of the idle current by the use of reactances, but the idle current is not entirely eliminated, for it still circulates in the localised circuit formed by the reactance and capacity shunts.

Irregularity of wave shape may introduce idle currents, although his is by no means necessarily the case.



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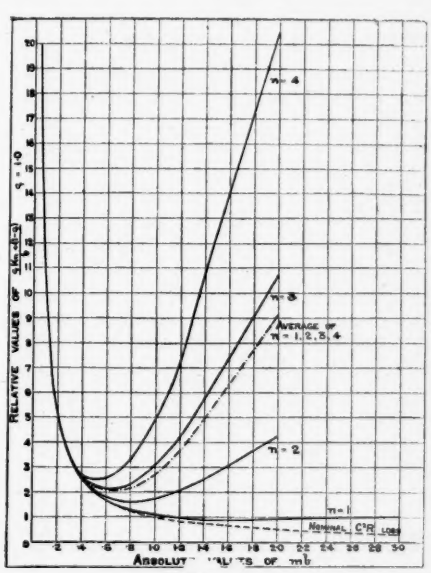

Fig. 4.

The currents circulating locally between the various units of a group of alternators running in parallel, may again represent an instance of idle currents. But, as in the last example, the cross-currents (though at all times undesirable) are not invariably idle, as they may represent a pulsating transference of power from one generator to another, and *vice versa*. This is the phenomenon of hunting or surging.

Passing over the various classes of idle current to be looked for in the external circuit, we will now turn our attention more particularly to those which are manifested inside the alternator, motor, or transformer, as the case may be.

The internal idle currents may be classified broadly under two heads: (*a*) Those whose magnitude is determined by the degree of excitation, and which depend very slightly, if at all, upon the load; (*b*) those whose magnitude is determined by the load and which depend very slightly, if at all, upon the excitation of the machine. Both produce a disturbance of the natural current density in the conductors of the machine, and increase the losses in consequence. The first class may be said to add a definite constant loss (for a given excitation) to whatever loss would be occasioned by the natural distribution of current density, while the second produce an additional loss proportional to the square of the working current, hence the actual loss may, in this case, be determined by simply assuming a *virtual increase of the resistance* of the circuit. The coefficient by which the actual resistance must be multiplied to allow for the additional losses depends upon the frequency, specific resistance, and dimensions of the conductor.

Large generators usually have two or more paths through the armature, and an uneven distribution of current between the various paths is equivalent to a uniform (or natural) distribution superposed upon a system of idle currents. Again, each path may be composed of two or more conductors, laminæ or strands in parallel, and an uneven distribution between them is equivalent to a natural distribution plus an idle current. Lastly, the distribution of current density in each individual strand may be far from uniform, so that here again we have an idle current superposed upon a natural distribution.

By a "natural" distribution we imply the distribution that would obtain if the current were continuous, and if no disturbing influences were brought to bear.

When we consider that we have so far only dealt with the main current-carrying circuits themselves, and allow ourselves to reflect upon the multiplicity of idle currents induced in neighbouring metallic bodies (core plates, pole-faces, &c.) we gain some idea of the many ramifications of the whole subject of "Idle Currents." The remedies, or partial remedies for idle currents of one form and another, as they exist in dynamo machines, are fairly well appreciated—*e.g.*, equalising rings connected to the windings of large continuous-current dynamos; the use of stranded and laminated conductors, &c. It sometimes occurs, however, that one particular class of idle current may predominate to a totally unexpected extent, and, in fact, a cooler, cheaper and more efficient machine may be obtained by a decrease of the amount of copper therein. As an illustration may be cited the ironless flat disk alternator, the armature consisting of copper strip wound into flat coils. Each strip, as it passes edgewise through the magnetic field, has an idle current induced in it.

With an armature wound with strip 2 mm. thick the additiona loss, due to disturbance of current density in the active part of

injunction, even if the cables would be between two works of the same owner. The matter may be somewhat slightly complicated by the fact that, although the Power Company has, we believe, powers over the whole area, these cables would possibly be run within an area, the local authority for which has also a provisional order. It would, however, be possible to run these cables outside the local authority's area. In that case, however, the Power Company would still cover the district.

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(*Abstract of Paper read before the* Institution of Electrical Engineers *at Manchester, February 13th*, 1906.)

The characteristic of every form of idle current here dealt with is that, while constituting a part of the *total* current flowing in the circuit, it may be considered, conventionally, as an altogether separate entity superposed upon the real useful current, and be treated as such.

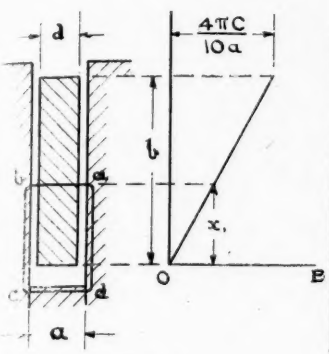


Fig. 1.

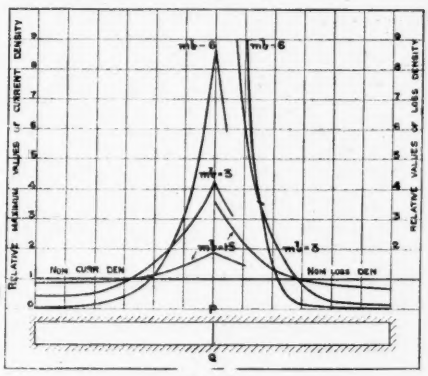


Fig. 2.

The idle current present when the power factor is not unity, frequently circulates throughout the entire circuit, and in such cases generators, mains, transformers, and other gear must be constructed with ampler proportions accordingly. The two main causes of the defective power factor are:—(*a*) Inductance in the load, as, for instance, when induction motors are largely employed; (*b*) capacity in the overhead lines or cables.

The only effective remedy in the first case, where the matter reaches serious proportions, is to run over-excited synchronous motors at the load end of the line. The calculation of the capacity of synchronous motors for the above purpose, in any specific case, is a matter of great simplicity, and need not concern us here.

The second instance enumerated above of defective power factor due to line capacity, only assumes serious proportions in the case of very long transmission lines at very high voltages. Suppose, for example, we consider a three-phase transmission line, 100 miles long, working at 80,000 volts, 25 cycles, the lines being 00 B. and S. arranged Δ-fashion 36 in. apart, and at an average of 30 ft. above the ground. It is a simple problem in electrostatics to calculate the current flowing into the line due to capacity effects. It works out approximately at 18 amperes per phase, or about 2,500 apparent kw. It will at once be seen that such an enormous apparent load for each set of three line wires would be a most serious item for the generating station to deal with.

The General Electric Co., of Schenectady, have manufactured reactances for voltages as high as 60,000 and for 2,500 apparent kw., for the purpose of relieving the generating station of the relatively enormous idle currents which are met with in such cases. It will, however, be observed that the use of synchronous motors and reactances does not cure the evil, but only mitigates it. In the first case the line and generators are relieved of the idle current, if the synchronous motors be situated at the far end, *i.e.*, the idle current is restricted to the environs of the load, circulating between the over-excited synchronous motors and the induction or other motors which constitute the load.

In the second case the generating machinery is relieved of the idle current by the use of reactances, but the idle current is not entirely eliminated, for it still circulates in the localised circuit formed by the reactance and capacity shunts.

Irregularity of wave shape may introduce idle currents, although his is by no means necessarily the case.

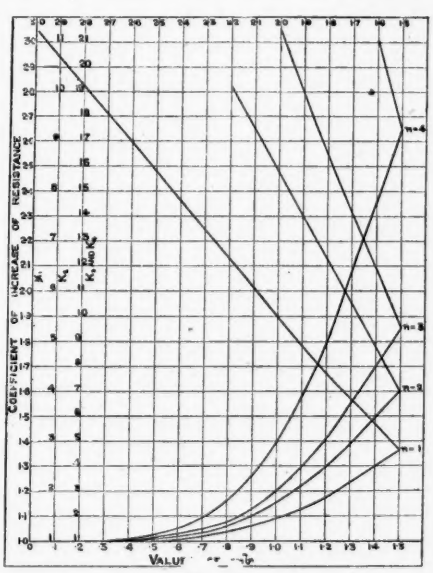


Fig. 3.

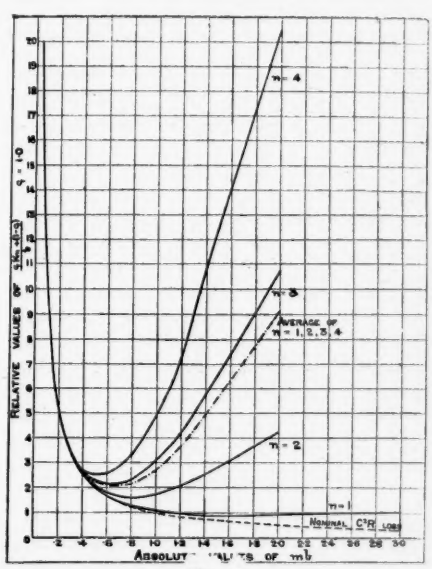


Fig. 4.

The currents circulating locally between the various units of a group of alternators running in parallel, may again represent an instance of idle currents. But, as in the last example, the cross-currents (though at all times undesirable) are not invariably idle, as they may represent a pulsating transference of power from one generator to another, and *vice versa*. This is the phenomenon of hunting or surging.

Passing over the various classes of idle current to be looked for in the external circuit, we will now turn our attention more particularly to those which are manifested inside the alternator, motor, or transformer, as the case may be.

The internal idle currents may be classified broadly under two heads: (*a*) Those whose magnitude is determined by the degree of excitation, and which depend very slightly, if at all, upon the load; (*b*) those whose magnitude is determined by the load and which depend very slightly, if at all, upon the excitation of the machine. Both produce a disturbance of the natural current density in the conductors of the machine, and increase the losses in consequence. The first class may be said to add a definite constant loss (for a given excitation) to whatever loss would be occasioned by the natural distribution of current density, while the second produce an additional loss proportional to the square of the working current, hence the actual loss may, in this case, be determined by simply assuming a *virtual increase of the resistance* of the circuit. The coefficient by which the actual resistance must be multiplied to allow for the additional losses depends upon the frequency, specific resistance, and dimensions of the conductor.

Large generators usually have two or more paths through the armature, and an uneven distribution of current between the various paths is equivalent to a uniform (or natural) distribution superposed upon a system of idle currents. Again, each path may be composed of two or more conductors, laminæ or strands in parallel, and an uneven distribution between them is equivalent to a natural distribution plus an idle current. Lastly, the distribution of current density in each individual strand may be far from uniform, so that here again we have an idle current superposed upon a natural distribution.

By a "natural" distribution we imply the distribution that would obtain if the current were continuous, and if no disturbing influences were brought to bear.

When we consider that we have so far only dealt with the main current-carrying circuits themselves, and allow ourselves to reflect upon the multiplicity of idle currents induced in neighbouring metallic bodies (core plates, pole-faces, &c.) we gain some idea of the many ramifications of the whole subject of "Idle Currents." The remedies, or partial remedies for idle currents of one form and another, as they exist in dynamo machines, are fairly well appreciated—*e.g.*, equalising rings connected to the windings of large continuous-current dynamos; the use of stranded and laminated conductors, &c. It sometimes occurs, however, that one particular class of idle current may predominate to a totally unexpected extent, and, in fact, a cooler, cheaper and more efficient machine may be obtained by a decrease of the amount of copper therein. As an illustration may be cited the ironless flat disk alternator, the armature consisting of copper strip wound into flat coils. Each strip, as it passes edgewise through the magnetic field, has an idle current induced in it.

With an armature wound with strip 2 mm. thick the additiona loss, due to disturbance of current density in the active part of

the armature conductors, is greater than the nominal C^2R loss. It is to be feared that this state of affairs exists in a considerable number of machines in use at the present time. The result of using thinner strip might be to reduce the heating, and might increase the efficiency and provide a lighter and cheaper machine. For the same reason it is clear that an increase of the specific resistance would cause a decrease of the total losses; hence we have the somewhat paradoxical condition that the efficiency improves as the temperature increases.

In 1903 Dr. Simon Ottenstein gave the results of tests made to determine, among other things, the "eddy current loss" in solid copper conductors laid in slots, due to the radial and tangential components of the flux within the slot *which emanates from the field magnets*, this flux being quite independent of the load current in the armature conductors. The armatures experimented upon had a diameter of 225 mm. and the slots were dimensioned in the different armatures as follows:—7 × 22·5, 7 × 35, 9 × 35·5, 7 × 23, 8·5 × 23, 14 × 11·75, the first dimension giving slot width and the second the depth in mm.

In the different experiments the theoretical tooth induction varied from 18,000 to 31,000, and the eddy current losses in the various solid conductors employed were found to be equivalent to the loss that would have been occasioned by a current density of from 400 to 4,700 amperes per sq. in. in the active portion, depending upon the size and position of conductor, dimensions of slot, air gap and nature of polar surface. The frequency in all these experiments was 33·3.

In the remainder of this paper, we refer to the ununiform distribution of an alternating current over the cross-section of a rectangular conductor surrounded on three sides by iron laminations.

The two previous examples cited are cases where the magnitude of the losses is dependent upon the degree of excitation and not upon the load on the machine; the following, however, represent the other case, where the losses are dependent upon the load current and not upon the degree of excitation.

In fig. 1 we have represented a copper conductor of depth b cm. and thickness d cm. lying in a slot of a laminated armature. An alternating current flows in the conductor in a direction at right angles to the plane of the paper, the plane of lamination of the armature plates corresponding with that of the paper. We shall show that the current flows in layers, being densest in the outside layers at the mouth of the slot, and least dense at the root. For this reason we have thought that the term "lamellar effect" is not out of place in describing this phenomenon. It is, of course, closely allied to the skin effect in a circular conductor, where the idle currents flow in one direction along the peripheral portions, and in the opposite direction along central portions.

The effect of any current flowing down the conductor in fig. 1 will be to produce a magnetising flux across the slot from side to side. If the width of the slot be small compared with the depth, the lines will be very nearly straight from wall to wall, except near the mouth of the slot, where they will bow outwards.

If $a\,b\,c\,d$ be a line of force, we know that the total magnetic force taken round the closed path will be $\frac{4\pi}{10}$ times the total current in amperes, in that portion of the conductor enclosed within it. Now, the magnetic resistance of the iron portion of the path, *i.e.*, from a to d to c to b, is negligible in comparison with the air portion from b to a, hence we may say with great accuracy that the density of the cross induction at x equals $\frac{1}{a}\,\frac{4\pi}{10}$ times the current in amperes flowing in the conductor between the limits $x = 0$ and $x = x_1$. The induction density at the mouth of the slot is therefore $\frac{4\pi}{10}\,\frac{c}{a}$, where c is the total current flowing in the conductor; and the induction at the slot root is zero. If, now, we suppose that the density of the cross-induction increases uniformly from zero value at the root of the conductor, to $\frac{4\pi}{10}\,\frac{c}{a}$ at the top edge, the total flux traversing the conductor will be—

$$\frac{4\pi}{10}\,\frac{c}{a}\,.\,\frac{b}{2}$$

per cm. length.

Consider a very thin lamina along the top edge of the conductor forming, in conjunction with a similar lamina along the lower edge, a loop through which this total flux threads.

The E.M.F. induced in this loop per cm. length of conductor will be—

$$\frac{4\pi^2}{10}\,\frac{b\,f\,c}{a}\,10^{-8}$$

volts, where f is the frequency of alternation. This expression gives the R.M.S. value of the volts, if c represents the R.M.S. value of the current. If the conductor be long in comparison with its cross-section, such an E.M.F. will produce an idle current density flowing in the loop of value

$$\frac{2\pi^2}{10}\,.\,\frac{b\,f\,c}{a\,\rho}\,10^{-8}$$

where ρ is the specific resistance in ohms—cm.

As an example, we will write $f = 50$, $b = 5$ cm., $\frac{d}{a} = 0{\cdot}7$, $\rho = 1{\cdot}9 \times 10^{-6}$ (at about 45° C.), when the value of the idle current density works out at about $2{\cdot}6\,\frac{c}{a}$; but the nominal current density is $\frac{c}{5d}$; hence the idle current density in the outer layers is over nine times the nominal current density when worked out on this basis, and the loss density (or loss per cb. cm.) at the extreme edge due to the idle current is over 80 times that due to the nominal current density.

This example has been cited to show in a rough and ready way that some phenomenon occurs in such conductors, which is well worth studying. The assumption made that the distribution of cross flux is that which would be given by a uniform current density is obviously disproved by the result of the calculation, and the actual redistribution of the cross flux is such as materially to reduce the estimated idle current effect. While, therefore, the above result is greatly exaggerated on account of the assumption made, it may be mentioned that machines are at work to-day where the loss density in the outer edge of the conductor is as much as 30 times that due to the nominal current density.

Fig. 2 represents the case of two conductors lying in a closed slot, current flowing up one and down the other.

The effect in each conductor will be the same as if we had but one conductor lying in an open slot, of which the mouth was at P, Q, except for the fact that the tendency of the lines to bow outwards at the mouth will here be largely neutralised. Curves in fig. 2 show the distribution of current and loss* density in the conductors, it being assumed that $f = 50$; $\frac{d}{a} = {\cdot}61$, and b has the values 1·875, 3·75, and 7·5 cm.

Those interested in the subject will do well to study A. B. Field's paper before the American Inst.E.E., where the necessary solutions are obtained for solid, stranded, and laminated conductors, as well as for a variety of types of former-wound coils.

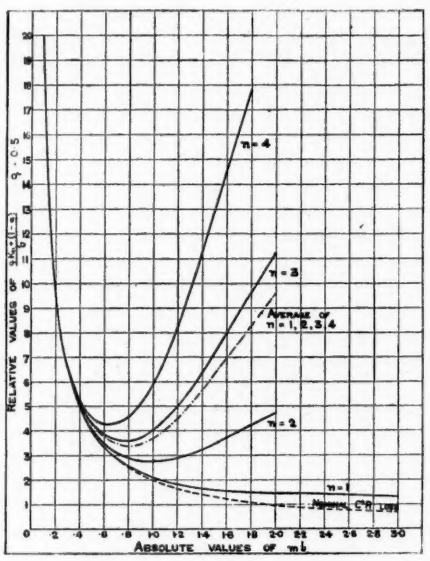


FIG. 5.

The important fact to determine is how much greater is the actual ohmic loss due to the ununiform distribution, than the nominal loss, or that calculated on the assumption of uniform distribution.

For this purpose we have only to consider the maximum values of the current at varying depths, and do not need to trouble about the relative phase relations.

The values of the current density at different points of the conductors shown in fig. 2 are plotted corresponding to the three cases $m\,b = 6$, $m\,b = 3$, and $m\,b = 1{\cdot}5$. If we take $\frac{d}{a} = {\cdot}61$, $f = 50$, then $m = {\cdot}8$,† and the above values will correspond to depths of conductor 7·5 cm., 3·75 cm., and 1·875 cm. respectively. Where there are more conductors than one in a slot, current flowing in each in the same direction, these effects are greatly magnified in the upper conductors.

It must be borne in mind that the phase of the current is not the same at all points of the conductor, but a continuous change of phase occurs from one edge to the other. For example, in the case where $m\,b = 3$ the current at the outer edge (PQ) is 45° in front of the load current; while the current at the root of the slot lags 127°, making a total phase difference of 172° between the current at mouth and root. In fig. 2 the values of the square of the current density have also been plotted, showing how enormously the loss-

* The loss density at a point is the loss per cb. cm. at that point.

† $m^2 = \frac{4\pi^2 f}{\rho}\,.\,\frac{l_1}{l}\,.\,\frac{d}{a}\,.\,10^{-9}$, where $\frac{l_1}{l} = 1$ if the length of the slot be relatively great.

density increases towards the outer edge of the conductor. The mean height of these loss-density curves, or what is the same thing, the ratio of the area of the actual to the nominal loss-density curve, represents the coefficient of virtual increase of resistance of the conductor, or the ratio of the actual to the nominal ohmic loss.

The constant by which the nominal ohmic loss per cm. must be multiplied, in order to determine the actual loss in a given conductor, or the coefficient of increase of resistance, depends entirely upon the depth of the conductor, the frequency, specific resistance, and the ratios $\frac{d}{a}$ and $\frac{l_1}{l}$. If the length of the slot be great in comparison with the other dimensions, the latter ratio may be taken as unity for a solid conductor.

The curves in fig. 3, plotted from the results given in Mr. A. B. Field's paper, already referred to, correspond to $n = 1$, $n = 2$, $n = 3$, $n = 4$, *i.e.*, for cases where slots contain 1, 2, 3 and 4 conductors connected in series, current flowing in the same direction in each. The curves apply merely to that part of the conductors lying within the slot, and show how many times the actual loss is greater than that calculated from Ohm's law.

As examples illustrative of the use of these curves, we will take the case of a four-layer winding, the depth of each conductor being 1 cm., frequency 50. Let $\frac{d}{a}$ be ·61; we have then $m = ·8$.

Referring to the values of K corresponding to $m\,b = ·8$ for the 1st, 2nd, 3rd and 4th conductors respectively, we obtain the values 1·04, 1·3, 1·85 and 2·6—that is to say, that while the nominal loss is increased by the idle current effect to the extent of 4 per cent. in the lowest conductor, it is increased 2·6 times in the topmost conductor.

When we find in any machine that the idle current loss largely exceeds the nominal loss, and bear in mind that the one increases while the other decreases with the copper section, we are naturally led to inquire whether an actual diminution of the amount of copper may not improve the efficiency.

Suppose q is the ratio of the active length of the conductor to the length of a half-turn. Let us now keep a, d, C and all other dimensions the same, varying only b, and for the present let us call $m = 1$. The nominal loss per cm. length is P/b where $P = \frac{\rho C^2}{d}$, and the actual average loss per cm. is $\frac{P}{b}(q\,K + (1 - q))$ where K is the coefficient corresponding to the value $m\,b$. If we plot $\frac{P}{b}$ vertically and b (or $m\,b$ where $m = 1$) horizontally, we obtain, of course, a rectangular hyperbola. If, now, we multiply each value of P/b by the corresponding value of $\{q\,K + (1 - q)\}$ we obtain the actual loss for each value of b, m being unity. This curve shows a minimum value, *i.e.*, there is a certain critical value of b giving minimum loss, and this critical value is evidently independent of the value of C. If we double b, the nominal loss is halved, but if at the same time we halve m, the K coefficient remains unchanged; hence the curve last referred to applies equally well for $m = ·5$, if for any given point of the curve we multiply the reading of the abscissa by two, and the reading of the ordinate by a half. Or, if we consider that the abscissæ represent values of $m\,b$, instead of b, we do not need to change their scale.

Hence we observe that, for all values of m, the point of minimum of the curve occurs at the same value of $m\,b$. Figs. 4 and 5 show these curves plotted for $n = 1$, $n = 2$, $n = 3$, $n = 4$, $q = 1$, and $q = ·5$.

These curves show the relative losses when m is kept constant at any value and b is varied, but it must be remembered that when m is changed, the vertical scale is changed proportionately. They show, moreover, the value of $m\,b$ at which minimum loss always occurs.

In figs. 4 and 5 we have also shown the relative values of the nominal loss, as also the average value of the four curves for $n = 1$, 2, 3 and 4.

Referring to fig. 4, where $q = 1$, *i.e.*, for the case where the whole length of conductor is active, it will be seen that, no matter what current we require to take out of the conductor, the minimum loss for the lowest is obtained when $m\,b = 1·4$, for the second when $m\,b = ·8$, and so on.

If, now, we put—

$$f = 50, \frac{d}{a} = ·61, \frac{l_1}{l} = 1,$$

so that $m = ·8$, the critical depths of conductor are 1·75, 1, 0·8 and 0·7 cm. for the 1st, 2nd, 3rd and 4th respectively. Any additional depth means an increase of loss and a waste of copper, no matter how large a current the machine may have to supply.

It also follows that if this critical depth be exceeded, an increase of specific resistance may decrease the loss, hence that the efficiency of the machine may actually improve as the temperature increases.

In fig. 5 the curves correspond to $q = ·5$, *i.e.*, where half the total length per turn is active. The average-loss curve shows the critical value of b for a coil of four layers of solid conductor. For the same value of m as above, this critical value works out $b = 1$ cm.

Although we have determined the critical depth for a four-layer coil, provided the same section of conductor is used throughout, a little consideration will show that by grading the section of the conductor in the different layers a still better arrangement may be arrived at. Remembering that when $m\,b = ·8$ a depth of 1 cm. has already passed the critical value of the outer layer, and has not yet reached that for the lowest layer, it follows that a more efficient arrangement will be obtained by transferring some of the copper from the outer to the inner layer.

If $q = 0·5$, from curves when $m = ·8$, $b = 1$ for all layers, we have a total loss in four turns = 1·36 times the nominal loss.

Let us now suppose that the inner turn has a depth of 1·5 cm., the second 1 cm., the third and fourth ·75 cm., thus making up 4 cm. total depth of copper as in the last case; then we have a total loss 1·27 times the nominal loss with uniform section.

(To be concluded.)

The Internal Energy of Elements.

By Prof. Soddy, M.A.

(*Abstract of Paper read before the* Institution of Electrical Engineers, *Glasgow, March 13th*, 1906.)

It is recognised that the energy possessed by any system cannot be known unless it is possible to change the state of the system. On the other hand, where it is possible to change the state of the system, the difference in the energy contents of the initial and final states can be found, but not the total energy-content of either state. In the transformation which matter undergoes in ordinary chemical changes, the change of energy accompanying the change of state can readily be found, but not the total energy possessed by either state. None of the material changes dealt with in chemistry are very profound. For this reason chemistry affords no indication of the internal energy of the elements. The latter cannot be fundamentally changed or converted the one into the other. Since in all chemical changes they remain essentially intact, their internal energy must remain always constant and therefore latent and unknowable.

The discovery of the natural radio-activity of certain elements—first for the element uranium by M. Henri Becquerel in 1896, and later for the element thorium—threatened to undermine the foundations of physical science, for the property of radio-activity involves a spontaneous and continuous evolution of energy, which goes on from year to year, and for all we know from one geological epoch to another. It is not affected by temperature, or by any other agency with which we are acquainted. The radio-active elements are without exception those which possess the heaviest atoms, and therefore presumably are those possessing the most complex structure known. The quantity of energy evolved is extremely small in the case of the common and older-known elements uranium and thorium, but it is manifested in a way which lends itself very readily to detection and investigation. The elements in question possess the power of emitting new kinds of radiation with characteristic properties, and among the most important of these is the power possessed by the rays of ionising the air or other gases through which they pass. Radio-activity is an intrinsic property of the element, and owes its origin to a process to which we and the forces under our control are external. It is a property bound up with that inner existence of the element which, as we have seen, survives intact the transformations due to all chemical changes, and against which the efforts alike of the alchemist and the chemist have been directed in vain. It has long been known that thorium and radium possess the power of causing any object in their immediate neighbourhood to become temporarily radio-active, and this phenomenon is alluded to as the "induced" or "excited" radio-activity. This Rutherford showed to be due to the emanation. An exhaustive investigation of the radio-activity of thorium resulted in other discoveries being made, and as a result Rutherford, in conjunction with the author, in 1902, advanced a theory accounting for the phenomenon of radio-activity. On this view radio-activity was regarded as being due to more fundamental changes in matter than had hitherto been known, and in which the elements themselves underwent a species of natural transmutation into other elements.

A definite fraction, usually an infinitesimal fraction, of the total number of atoms was regarded as spontaneously exploding or disintegrating in each unit of time; the rays emitted were regarded as being due to the lighter fragments of the original heavy atom, expelled like projectiles with great violence and ionising the air molecules in their path; while the emanations and allied bodies were regarded as the residues of the original atoms left after the expulsion of these radiant particles. These emanations remain in existence on the average a definite short time, and then again suffer disintegration. In radium at the present time no fewer than eight successive disintegrations have been traced. The period of average life of the successive transition forms varies from years in some cases to a few seconds in others. The energy evolved per gramme of radium per hour is 100 calories, and so in one year amounts to 876,000 calories. In this time, between one-thousandth and one two-thousandth part changes, so that the total heat evolved during the complete change of one gramme of radium would amount to at least a thousand million calories. This is over a hundred thousand times greater than that evolved from a similar weight of coal burning. This calculation, although an experimental one, involves the assumption that the rate of evolution will be maintained over a period of about a thousand years, and is to this extent hypothetical.

We cannot regard the existence of this large internal energy as a peculiar property of the element radium. Rather we must regard all elements as possessed of stores of energy, which, while they no doubt vary for the different elements, are in all cases much greater than are ever associated with compounds. In the first place, radium, in its chemical properties, is a completely normal and typical element, and possesses a chemical nature almost identical with that of the element barium. Uranium was known long

before its radio-activity was discovered, and represents another perfectly normal chemical element. Yet uranium, since it produces radium with evolution of energy, must possess all the internal energy of radium and more. It is probable that the elements, as a class, all possess great internal energy, and that their characteristics of stability and permanence, and the failure of all attempts to change them by artificial means, are due to the existence of this internal energy.

The forces at our disposal, compared to those which are exhibited when an atom suffers change, are of a different and lower order of magnitude, and it is not to be expected, therefore, that transmutation will become possible until we can control more powerful agencies than are at present available. But there is no saying, now we are assured that we are on the right track, how or when a discovery may be made which will put into our hands the key which will unlock this great store of energy bound up in the structure of the element. All attempts, so far, to accelerate the rate at which the store is being naturally evolved, in the case of the radio-elements, have been unsuccessful. Suppose that the element uranium, for example, which disintegrates to the extent of a thousand-millionth part annually, could be made completely to disintegrate in the course of a year. From one gramme of the element more than a thousand million calories could be evolved, and this, if it could be converted into electrical energy, would be equivalent to more than 1,000 KW.-hours, and would suffice to keep a 32-C.P. lamp burning continuously throughout the year. By the expenditure of about 1 ton yearly of uranium, costing less than £1,000, more energy would be derived than is supplied by all the electric supply stations of London put together. One little step, so easily anticipated in imagination, so insignificant even in comparison with all that has been accomplished in the past, divides us from this magnificent inheritance.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Tramcar Brakes.

We notice your comments on Mr. Fell's paper on "Brakes" in last week's issue of the ELECTRICAL REVIEW, and should like to offer a few remarks.

The statement that with the electro-magnetic brake no discernible interval elapses between the action of moving the brake handle and the commencement of the act of braking, can only be accurate if the controller happens to be in the "off" position when it becomes desirable to apply the brake. It is quite conceivable that an emergency might arise when the controller is on the seventh notch, and, in that case, the controller handle must make about two thirds of a revolution before the first brake notch is reached. This operation will certainly occupy some appreciable period of time.

With the air brake, the interval that elapses between the moving of the brake lever and the commencement of the act of braking is represented by the time occupied by the compressed air in entering the brake cylinders. With the air brake, the driver can open the brake valve at the same moment as he commences to move his controller handle, so that by the time the controller reaches the "off" position the air brake is taking effect, that is, one notch in advance of the electro-magnetic brake.

We must also take exception to your statement that Mr. Fell, by his tests, has demonstrated to the world that the electro-magnetic brake is not only the best, but is far in advance of any other. You, yourselves, point out that Mr. Fell made no tests with air brakes, and we are surprised that you should consider the results obtained to prove conclusively that a particular type of brake is far ahead of all others, when its only serious competitor was not included in the tests.

Before electro-magnetic brakes can lay claim to be far in advance of any other brake, they must be remedied in at least three defects, with which they are at present burdened, which are:—

First, the electro-magnetic brake depends upon the revolutions of the wheels to make it operative.

Secondly, if the car is running backwards down a hill, it is necessary to reverse the controller before the electro-magnetic brake can be applied. Numerous accidents have occurred through the driver's omission to do this, the last recorded case being at Huddersfield, an account of which appeared in your issue of March 9th last.

Thirdly, the driver has no means of ascertaining, whether he has any, or what braking power at his disposal at any given moment.

Until these defects in the electro-magnetic brake are overcome, we maintain that the air brake is far in advance of the electro-magnetic brake.

Estler Bros.

London, E.C., *March 26th*, 1906.

[The air-brake has its advantages: but, like any other, it has its disadvantages, and it is not in the braking effect, but in the provision of the compressed air, both in first cost and in maintenance, that it is handicapped. We cannot admit that the speed of action of the air-brake is greater than that of the electro-magnetic brake, even when the controller handle is on the 7th notch to begin with: on the other hand, the former is certainly entitled to commendation on the score of its complete independence of the continued rotation of the wheels. The regenerative shunt-wound motor, of course, acts as a brake without reversal.

We have been reminded that the mechanical track brake designed by Mr. R. H. Wilkinson, general manager and engineer of the Huddersfield tramways, can be applied instantaneously. On the other hand, no mechanical brake can get a grip on the rails comparable with that of the magnetic brake, and when the latter is used as the service brake, as is frequently the case, the driver becomes familiar with its use.—EDS. E.R.]

Preservation of Hanger Bolts.

I am greatly indebted to Mr. Dixon for his striking testimonial to the real need for the hanger shield which I have patented, and I can assure him that before that step was made, the necessary precautions to ensure validity were taken. My experience has been wholly with inland tramway systems, and the ill-effects of the leakage which always follows the wetting of the hanger bolt, were independent of the "extra saline" action which is sure to occur on the sea coast.

Although these shields have been on the market for a few months only, the sales have demonstrated in no uncertain way that the trouble which they are intended to prevent is both widespread and serious, and that tramway engineers are glad to have at their command such a simple and inexpensive remedy. After Mr. Dixon's letter the sales ought to increase at a far greater rate.

Robert N. Tweedy.

Stourbridge, *March 23rd*, 1906.

In connection with the overhead tramway equipment of which I have charge, the whole of our feeders are fixed overhead, and are of bare 4/0's hard-drawn copper, supported in a similar manner to the trolley wires, and I find that the insulated bolts supporting the feeders corrode in exactly the same way as the trolley-wire insulated bolts. Of course, no trolley runs over the feeder, in which case, does it not seem that Mr. Tweedy's theory, that the trolley throws up rain water into the hanger, must collapse? The corrosion on the feeder insulated bolts is as bad (if not worse) as on the trolley-wire bolts.

Jno. Wm. Warr.

St. Helens, *March 24th*, 1906.

Wiring Conduits.

Mr Vandy in a recent issue raises the question of the insufficiency of enamel (unless the tube is coated after erection) to afford protection against rust which attacks all classes of steel tube so readily. A good plan appears to be the adoption of wrought-iron tube, which, even without further treatment, is not liable to rust through.

Electrical engineers have a grievance against tube-makers who spend so much time and money influencing architects and others who have no practical experience. They show polished samples and advertisements of conduits which have all the glitter of a German toy. The result is, the layman gets enthusiastic over material which, in a few years, develops into a streak of corruption. Of course, I refer to those conduits of very light gauge, whether slip or

screwed, and consider that all tubes fitted should be of a decent thickness.

On the matter of continuity couplings, some years ago I tried types of compression coupling, but abandoned them as being clumsy. Some of those now on the market present a clear channel, presented by the split in the nipple, for water to run into the tube; and again, continuity of the conduit is seriously interfered with by the multiplication of surfaces, which greatly increases the resistance of the coupling.

I found that if the tube was supplied to the workman tapered to fit similiar machined sockets on the coupling, and in addition a screw, set at right angles, was made to bear on the tube, then you have a coupling of the lowest resistance, and one that is steam tight. The fact that the tube ends are coned ensures their exact fit, even should the tube diameter itself vary. No time is lost in screwing, and one avoids most of the dangers and troubles which screwed conduit involves, whether the thread be gas or bastard.

D. S. Munro.

Glasgow, *March 24th*, 1906.

The Naval Engineers and Electricity.

I think that the two anonymous correspondents who have criticised my article are under the impression that I wished to attack Mr. C. H. Wordingham in his present arduous position. I wish to deny this at once, my remarks being levelled at the system. Unfortunately, just at present I am suffering from serious indisposition, or I would enlarge upon this question. I may, however, perhaps, be permitted to say that the anonymous correspondents strike me as being rather unmanly, for, if their criticisms are just, why not append their signatures? I cannot pass "Tyro's" letter on the education question without thanking him for it, and when in a few weeks I have recovered, I will reply to him.

C. Alfred Smith.

London, W.C., *March 26th*, 1906.

Shift Engineers' Holidays.

I entirely agree with a correspondent signing himself "De Profundis" that the reason why the present rate of salaries paid to central station men is so low is because the market is glutted with pupils, &c., who I know for a fact offer their services free. I am referring to Technical College pupils only, not engineering works pupils.

Again, take the case of a small station. The shiftman—we won't call him engineer yet—commences as a switchboard attendant, 25s. per week or less. Probably previous to this he had been a wireman's mate or employed in a small manufacturer's shop—no apprenticeship of any sort required. What is to prevent that man—who, to gain further experience, will work for almost nothing—from taking a "shift engineer's" job? (See page 415, *Electrical Engineer*, March 23rd, 1906.) How often do we see in your papers: "Switchboard attendant wanted, with a view to becoming a shift engineer; wages 20s. per week." Where, as regards one detail, does that man's mechanical knowledge come in?

These, then, are a few instances which make the lot of a station engineer worthy of the name so odious. He knows that to complain is to run the risk of being supplanted by one of these "blood money jacks-of-all-trades."

In looking through some old Reviews, say, 1898, one sees "Engineers-in-Charge" wanted, salary £116—£130 per annum. Now it is Switchboard-Attendant or Engine-Driver-Cleaner, with a knowledge of the three-wire system. Anyhow, chief engineers seem to get who they want. A Union might be formed, however, to prevent only indentured men from calling themselves engineers.

Old Reader.

U.D.C. Promptness.

I heartily sympathise with "Disgusted," who is very lucky to get an answer to his application, and more so to get his testimonials returned to him. In my case I have, within the last three months, answered 14 advertisements out of your columns, the majority being municipal authorities, and I have only had two replies, one of which returned my references. Now, each of these applications represents an expenditure of 5d. for typewritten copies of references, paper, envelope and postage, and I think the advertisers could at least return the references, or failing that, send out a post-card notifying the applicants of their non-success. It is a well-known that one-half the appointments made are pre-arranged affairs; but why advertise them in technical papers? It is a great injustice that such things are allowed to be arranged, but it is a far greater injustice to the struggling applicant, whose applications are, if opened, either thrown ruthlessly into the waste paper basket, or left to the tender mercies of female clerks and irresponsible office boys. I appeal to you, Mr. Editor, that such treatment by business men, who consider themselves gentlemen, is neither gentlemanly or businesslike. Is there any justifiable reason for such contemptible behaviour?

It appears to my mind that we (the middle-class electrical workers) have to thank the glorified working man for it, and in the near future we shall be crushed out of existence by the *protéges* of these human parasites, who pose as unpaid martyrs, and who will as surely bring the inhabitants of the United Kingdom down to the degrading level of paupers, even as they have done the population of our Australian Colonies.

Women have invaded the general office, now the drawing office, displacing men who have families dependant upon them, and who are now filling the ranks of the unemployed, so it is very possible we shall have them in the engine room next.

I do not advocate a Trade Union as a remedy: I dislike its constitution and methods, but there is, I believe, an Association of Charge Engineers which could take up the question of organisation, and attempt to improve our status without the doubtful luxury of stuffy club-rooms, cheap billiards and sick benefits, which, I feel sure, are not much attraction to the majority of shift engineers.

Another thing I have noticed is the prevalence of advertising under a box number; that I consider a reprehensible practice, contemptible in the extreme, and adopted in many cases to entrap employés, but more often by persons whose establishments have become notorious from managerial or structural defects, perhaps both, who would not get a solitary applicant if their names were known.

The remarks of "De Profundis" are very true; it is time the "glittering illusion" was dispelled, but moneyed amateurs will meddle with everything.

Ci-Devant E-in-C.

Factory Act Prosecution.

With reference to the note as above in your issue of the 23rd inst., we beg to state that we were fined £1 and costs in each of two cases only. The third case was dismissed.

Regarding the severity asked for by Mr. Seal, we may quote for comparison the previous case, quite an ordinary one, in which the defendants were also fined £1 and costs. The girl mentioned by Mr. Seal did not tell him an untruth regarding her age, and nothing was given to her with the idea of instigating a false declaration. Small sums are frequently given in the way of bonus, and this extends to all of our employés.

We shall be glad if you will kindly find room for this communication.

Rhodes Electrical Manufacturing Co.,
W. J. Axworthy, *Works Manager.*

Bradford, *March 27th*, 1906.

The Single-Phase Induction Motor.

I cannot agree with Mr. Fynn that the E.M.F. E R in the axis D D, makes any difference to the effect, owing to which the E.M.F. E S vanishes at synchronism. I had thought that the mention of this effect would have recalled to his mind that it was clearly described by Atkinson in his well-known paper for the case of the polyphase motor, which he treats in the same way as that adopted by Mr. Fynn for the single-phase motor (see Min. Proc. Inst. Civ. Eng., Vol. CXXXIII., p. 138). Mr. Atkinson even lays considerable stress on this effect, calling it a "most important addition" to the effects

found in a transformer. However, in order to include the E.M.F.'s E T and E R in the working, I will go over the ground again.

Interlinked with the armature circuit C C are two fluxes : (1) the flux of mutual induction M between primary and secondary ; (2) the secondary leakage flux M_2. Tracing the effects of these fluxes :—

1. In the circuit C C,

M produces the E.M.F. E T = T N_1 M lagging 90° behind it.
M_2 „ „ „ E S = T N_1 M_2 „ „ „

2. In the circuit D D,

M produces the E.M.F. E R = T N M opposite in phase to it.
M_2 „ „ „ E R_1 = T N_1 M_2 „ „ „

So far we are agreed. At this point, however, Mr. Fynn prefers to compound E R and E R_1, and to consider the resultant as the E.M.F. to which the current in the circuit D D is due. I have preferred to keep the two E.M.F.'S separate, regarding each as producing its own current. I think also that I have failed to make my notation quite clear, since Mr. Fynn says that the fact of expressing (E T — E B) as a difference presupposes exact phase opposition. Such an expression, when used by me, means that E T and E B are to be compounded vectorially in their proper phases. This notation is extremely simple, and avoids much circumlocution. This being understood, and Z being the impedance of the circuit D D, we may say that the current in D D is—

$$\frac{E R + E R_1}{Z} = \frac{E R}{Z} + \frac{E R_1}{Z}, \text{ or } C_2 = C_2^{I} + C_2^{II}.$$

The first member of this equation corresponds to Mr. Fynn's procedure, and the second to mine. Both are obviously identical. Each of these currents will clearly lag behind its E.M.F. by the same angle, which is also the same as that by which the resultant current lags behind the resultant E.M.F. This latter proposition is easily proved by similar triangles.

To proceed. As in my previous letter, I neglect the resistance of D D.

3. The current C_2^{II} produces the flux $M_3 = \frac{N}{N_1} M_2$.

„ „ C_2^{I} „ „ $M^{I} = \frac{N}{N_1} M$.

The reasons why the fluxes M_3 and M^{I} have the above magnitudes are set out in my previous letter.

4. M^3 produces an E.M.F. of rotation E B_1 = T N M_3 in C C.
M^{I} „ „ „ E B = T N M^{I} „

Substituting the values of M_3 and M^{I}, we have

$$E B_1 = \left(\frac{N}{N_1}\right)^2 T N_1 M_2 \quad E B = \left(\frac{N}{N_1}\right)^2 T N_1 M.$$

Hence in the axis C C the fluxes M_2 and M produce total E.M.F.'S—

$$\left(1 - \left(\frac{N}{N_1}\right)^2\right) E S \text{ and } \left(1 - \left(\frac{N}{N_1}\right)^2\right) E T.$$

In fact, it is easy to see that every effect produced by M must, on a small scale, be also produced by M_2, since both act under exactly the same conditions. Moreover, any reason which renders it imperative to compound E R and E R_1 before finding the current in D D_1 also renders it imperative to compound the fluxes M and M_2, before finding the E.M.F. in C C.

Mr. Fynn has, I think, misunderstood my statement that in a motor designed for speed variation by varying the motor field, the free speed of the motor is that at which E S vanishes. I did not mean to state that the vanishing of E S determined the free speed, but merely that the free speed and the speed at which E S vanishes happen to coincide in such motors. With regard to the question of the no-load current, I admit that Mr. Fynn is right in his objection to my calculation of the no-load power-factor. However, in his letter of the 24th he states that the magnitude of the no-load current is due to the losses. To use his own words :—"There are quite a number of losses to be taken into account which increase the watt component of the no-load current very materially." It is to this that I take exception. I maintain, and am prepared to prove, that, as a limiting case, a motor entirely devoid of losses and leakages will take at no load a current equal to twice the magnetising current. The fact that actual motors take less than this is entirely due to these losses and leakages (principally the latter).

I should like to ask, before concluding, whether Mr. Fynn numbers the Heyland diagram, both for the polyphase and single-phase induction motor, among those complicated and thoroughly complete diagrams for which he has no use. If so, I think he must be alone in that opinion. The theory of the single-phase motor abounds in difficult points, however it is treated, and in introducing a new theory I should have thought Mr. Fynn would have devoted special attention to the difficulties instead of giving a merely popular theory, which only evades them. These difficulties cannot be treated without mathematics. I do not wish to pose as a champion of the rotary field theory, as, on the contrary, I think that put forward by Mr. Fynn decidedly the simpler. All I wish is to make sure that it treats the known difficulties of the subject in a satisfactory way.

F. Creedy.

Bradford, *March 27th*, 1906.

Makers' Name.—A correspondent asks the name of the manufacturers of the Thermal Flame Arc Lamps.

PARLIAMENTARY.

London Tramway Schemes.

Amongst the Bills referred to the Select Committee of the House of Commons presided over by Sir J. Dickson Poynder are :—The Corporation of London (Blackfriars Bridge), which authorises the construction of tramways over Blackfriars Bridge, the London County Council Tramways Bill and the Middlesex County Council Tramways Bill.

On 22nd inst. Mr. Browne (Dyson & Co.) attended before the Committee and said that the Blackfriars Bridge Bill must be taken together with the L.C.C. and the Middlesex C.C. Bills, and as the two latter Bills were not yet through second reading, and as in addition the London County Council was applying for an additional provision which must delay the progress of that Bill, he asked the Committee to adjourn until after Easter.

Mr. Pritt, on behalf of the Corporation of London and the Middlesex County Council, supported the application.

Replying to the Chairman, Mr. Browne said that in all probability the second reading of the L.C.C. Bill would not be taken before March 29th, and as six clear days must elapse before the Bill could come to the Committee, it would not be possible to be ready before April 6th, and as the hearing of the Bills would take a good many days, if they started them they would have to break off in the middle at Easter.

After consultation the Committee fixed April 24th provisionally for taking the Bills.

The London Power Bills.

On Monday in the House of Commons the London County Council (Electric Supply) Bill was discussed at some length on a motion by Mr. W. F. D. Smith that it be read a second time that day six months.

Mr. Lloyd-George said the Government proposed to support the second reading of the Bill, and to move that it be referred to a hybrid committee, with a *locus standi* to all those who had petitioned against the Bill. They proposed to instruct the committee to consider, with special reference to this Bill, the best means of providing for a supply of electric energy in bulk, and for power and motive purposes, and to report thereon. That instruction would give very full powers to the committee to consider all the points that had been raised.

Mr. Lloyd-George was asked what was the objection to this and all the other power Bills being sent to the same committee, and in reply he said there was a very substantial objection to that ; priority ought to be given to the scheme of the ratepayers. He said that the Government did not accept the view that municipalities were not capable of going into enterprises of this character. London experience showed that the Councils were selling energy at lower rates than the companies. The amendment moved by Mr. Smith was withdrawn, and the second reading of the Bill was agreed to.

Mr. Stanley Boulter, one of the promoters of the "Additional" Co.'s scheme, has written to the Press, stating that the *locus standi* accorded to them is merely a power to appear and make objections to the L.C.C. Bill, and it is of no practical value whatever to them. Unless a second reading were given to the "Additional" scheme, it would not be worth while to enter upon a contest.

The *Times* of 28th inst. says that the proposal to refer the London County Council (Electric Supply) Bill to a hybrid committee is objected to by authorities on constitutional procedure, on the

ground that such a tribunal is, under normal conditions, exempt from the rules by which the judicial character of an ordinary Private Bill Committee is preserved. The members of a hybrid committee do not sign the declaration required from every member of an ordinary Private Bill Committee "that his constituents have no local interest and that he has no personal interest in the Bill," and "and that he will never vote on any question which may arise without having duly heard and attended to the evidence relating thereto." In view of the highly contentious issue raised by the L.C.C. Bill, the weight of the opposition, and the importance of the interests involved, it is submitted that the regulations applicable to Private Bill Committees should be imposed upon this hybrid committee as they were in a kindred case which occurred during the existence of the late Parliament.

Hammersmith, City and North-East London Railway Bill.—The Standing Orders Committee of the House of Commons has decided to dispense with Standing Orders and allow the Corporation of the Hall of Arts and Sciences to oppose the Bill.

Huddersfield Corporation Bill.—A Select Committee of the House of Commons, presided over by Mr. Wilson, has passed the Huddersfield Corporation Bill, which, amongst a number of other things, empowers the Corporation to construct six small sections of tramways. The estimates in the Bill include £5,340 for tramways, and £882 for electrical equipment.

Macclesfield and District Tramways Bill.—The Macclesfield and Tramways Bill, which incorporates a company with a capital of £135,000 to construct tramways in the County of Chester, should have come on Thursday, last week, before Sir J. Dickson Poynder's Select Committee of the House of Commons, but it being intimated that opposition was withdrawn, the Bill was referred to the Unopposed Bill Committee. It is proposed to construct tramways in Macclesfield, Tytherington, Butley, Adlington, Hazel Grove and Bramhall.

Mersey Railway Bill.—Last week, after hearing further evidence in opposition, the Committee, without calling upon Counsel for the promotors to reply, announced that they found the preamble of the Bill proved, and the Bill was accordingly ordered to be reported to the House.

Preston, Chorley and Horwich Tramways Bill.—The Select Committee of the House of Lords to which the above Bill was referred has reported that they have not considered it, as all opposition has been withdrawn.

Second Readings.—In the House of Lords on 22nd inst. the Folkestone, Sandgate and Hythe Tramways (No. 2) Bill was read a second time. The Standing Orders Committee of the Commons has allowed the Bill to proceed, provided the powers to construct No. 3B be struck out.

In the House of Lords on 22nd inst. the West Yorkshire Tramways Bill was read a second time, and in the House of Commons the North Metropolitan Tramways Bill was read a third time.

In the House of Lords on March 26th, the following Bills were read a second time:—Folkestone, Sandgate and Hythe Tramways (No. 1) Bill; Shropshire, Worcestershire and Staffordshire Electric Power Bill; and the Kent Electric Power Bill.

Government and the Telephones.—In the House of Commons on 27th inst., the Postmaster-General replying to a question, said that he had not made any definite offer to the Hull Corporation for the purchase of their telephone system. On two occasions representatives of the Corporation had discussed the question of purchase, first with his predecessor and again with himself. They were given to understand on both occasions that the Corporation were not prepared to entertain an offer of less than the repayment of the full capital expended. This was a price which made no allowance for depreciation, and was considerably higher than the valuation made by the engineers. In the interests of the taxpayer he did not feel justified in agreeing to such an arrangement. The Corporation had not further approached him on the subject. He understood that the National Co. had made an offer to purchase the Corporation telephone system, but the price to be paid by the telephone company, supposing their offer were accepted, would not in any way affect the price to be paid by the State in 1911 for the plant. The price would, under the agreement, be the then value of the plant, &c., which was purchased, having regard to its suitability for the purpose of the Postmaster-General's telephonic service.

Wireless Telegraphy Bill.—In the Commons on 26th inst., Mr. Hay objected to an amendment, carried at the instance of the Postmaster-General, making the Act run till 1912. This, he contended, tied the hands of Parliament in regard to wireless telegraphy for six years, though the science was advancing daily by leaps and bounds. He moved to limit the operation of the Bill to 1908. After some discussion the motion was rejected by a majority of 254.

Cricket.—The Eltradion Athletic Club (weak), are open to accept engagements at cricket with clubs connected with the electrical industry, at home May 5th and alternate Saturdays, several dates open. Communications should be addressed to the secretary, Mr. Thos. Grover, 108, Hall Road, Peckham, S.E., or the general office, Electrical Trades Union, Club Union Buildings, Clerkenwell Road, E.C.

BUSINESS NOTES.

Electricity on the new Cunarders.—According to the *Glasgow Herald* the electrical installation to be fitted on the Cunard steamer *Mauritania*, building at Wallsend by Messrs. Swan, Hunter & Wigham Richardson, Ltd., will be the largest and most complete ever fitted on board ship. The generating plant consists of four sets of Parsons turbo-generators made by Messrs. C. A. Parsons & Co., and each machine will be capable of producing 4,000 amperes at 110 volts. This machinery will be placed in the aft end of the engine-room in two separate compartments divided by a watertight bulkhead, and arranged in such a way that the ship would remain lighted in the event of either engine-room being flooded with water. There will be two switchboards, one in each compartment, for distributing the electricity throughout the ship. A large portion of the auxiliary machinery will be driven by electric motors, including 16 forced draught fans of 50 H.P. each for the stokeholds, and about 60 H.P. for the refrigerating machinery. Two electric passenger hoists are to be fitted for conveying passengers between the six decks, and also six smaller hoists for the conveyance of stores, mails, &c., and two large luggage hoists. Electric motors are to be fitted for raising and lowering the lifeboats, heaving in the sounding line, and for driving various machines in the bakery, galley, and pantry. In connection with the ventilation of the ship there will be about 60 large electrically-driven fans, including Stewart's patent thermotanks, for heating and ventilating the whole of the passenger accommodation. The electric lighting of the ship will require about 5,000 lamps of 16 C.P., which is more than double the number fitted on the steamer *Cedric*. In the staterooms *de luxe* there will be three lamps for lighting each room, electric fan, electric curling-tongs heaters for the ladies, and an electric radiator for heating the room independently of the general system. In addition to the usual electric bell system, there will be a telephone exchange fitted in connection with the first-class rooms and the principal officers of the ship, and special telephones from the bridge to the wheel-house aft, the forecastle head, and the engine-room. On the bridge deck there will be four powerful searchlights, and there will be two masthead and two side lights fitted with Martin's patent electric duplicate apparatus, which automatically replaces a broken lamp filament, at the same time signalling to the officer on watch that this has taken place. In addition to this, the steam whistle will be electrically controlled, and all the watertight doors throughout will be closed automatically by electric connection from the bridge. The electric installation will be fitted by Messrs. W. C. Martin & Co.

German Imports and Exports of Electrical Machinery.—The exports of electrical machinery from Germany during January last reached a total of 1,325 tons, as compared with only 996 tons in the corresponding month of last year. There was also an increase in the importation of foreign electrical machinery into Germany—from 101 tons in January, 1905, to 144 tons in the first month of the current year.

Labour Troubles at Salford. — A correspondent writes:—"A labour dispute is in progress at the works of the General Electric Co., Ltd., Upper Clemenson Street, Salford, in reference to contracts for the telephone department of the Postal service, and the dispute threatens to form the subject of questions by members of the Labour group in the House of Commons."

Prices Advance.—The Electrical Co., Ltd., of Charing Cross Road, announce that owing to still further rises in the price of raw material they will have to charge an advance of 10 per cent. instead of 5 per cent. (as already announced) on orders received after February 15th. On "Luna" flame arc lamps, the extra charge will remain 15 per cent., and on electroliers 5 per cent., as notified November 30th, 1905.

Roller Bearings.—In a discussion upon a paper read before the Scientific Society of the Technical College of Glasgow on "Forced Lubrication," on the 17th inst., it was stated that the roller bearings supplied by the Empire Roller Bearings Co., for Nobel's Explosive Factory were giving great satisfaction. We are informed that one of the bearings was taken out and examined the day before the lecture, and was found in perfect condition, after about 10 months' hard running. It was also stated that Messrs. Nobel were working 19 cartridge packing machines from their engine, but by the addition of these roller bearings they had increased this number to 46 machines with an increase of only 2 H.P., while their oil bill had been only one-tenth of what it previously was.

Coal-Handling Plant. — The Chain-Belt Engineering Co., Derby, recently installed a coal-handling plant at the extensive Manningham Mills of Messrs. Lister & Co., Ltd., Bradford, and has now received instructions to proceed with a second boiler-house plant for the same mills. The Derby firm also has in hand a complete coal elevating and conveying plant for the Grimsby Corporation electricity works.

Linolite.—The Linolite Co. has received an order for 450 ft. of Linolite for Petworth House, the residence of Lord Leckonfield, of Petworth.

Patent Amendment Application.—From a notice appearing in our other pages this week, it will be noted that Hans Kuzel seeks leave to amend specification No. 28,154 of 1904 for "Improvements relating to the manufacture of light-emitting bodies for electric incandescent lamps."

Book Notices.—*Reid's Handy Colliery Guide for Northumberland and Durham.* London and Newcastle: Andrew Reid & Co., Ltd. 2s. 6d.—In addition to a useful list of collieries and their engineers and other officials, including inspectors of mines, this book contains copies of the Coal Mines Regulation Acts, the Truck, Workmen's Compensation, Boiler Explosion and other Acts relating to collieries and colliery working, and, of course, the regulations relating to the use of electricity in mines.

The Registration of Earthquakes. By G. Agamennone. *L'Elettricista*, Rome.—The author, who is the director of the Royal Observatory of Rocca di Papa, describes the various instruments employed, and the principles underlying their construction, for observing or recording horizontal, vertical and undulatory motions of the earth's surface. Many of the instruments are naturally of a very complicated character, but the author—being a master of the problem—shows how he can make use even of an ordinary cupboard door on occasion. The inventors of the apparatus mentioned usually bear Continental names, perhaps indicating that less attention has been given to the subject in this country than abroad.

We have received a copy of the *Far Eastern Review*, an interesting and informing monthly publication published at Manila, Shanghai and Yokohama, in which appears a number of articles, illustrated and otherwise, relating to engineering, finance and commerce in Far Eastern countries. The London agents are Probsthain & Co., 14, Bury Street, W.C.

The November number of *The Italian Electro-Technical Journal* concerns the visit of the Institution to America during the months of August and September in 1904. An introduction with copious reproductions of snap-shots is written by Prof. Ascoli. The party received special attention from Mr. J. W. Lieb, who evidently did all that he could to impress the visitors favourably with the works of importance which they saw. Other articles describe the central stations visited; the manufacturing works; electric traction undertakings and electric railway works, and an account is given by Engineer Soleri of the electric equipment at the St. Louis Exhibition.

"Science Abstracts." March 26th, 1905, Vol. 9, Part 3. Sections A and B. London: E. & F. N. Spon, Ltd. 1s. 6d. each.

"Tabelle der Prozentualen Spannungsverluste." By Fritz Jesinghaus. Berlin: Julius Springer. 50 pf.

From the British Fire Prevention Committee we have received a pamphlet containing four of the fables for children on "The Danger of Playing with Fire," which were awarded prizes in the recent competition.

"Electric Machine Design," being a Revised and Enlarged Edition of "Electric Generators." By H. F. Parshall and H. M. Hobart. London: Offices of *Engineering*.

"Annalen der Elektrotechnik fur das Jahr 1906, No. 1, January. Darmstadt: Geschäftsstelle der Annalen der Elektrotechnik.

"Single-Phase Commutator Motors." By F. Punga; translated by R. F. Looser. London: Whittaker & Co. 4s. 6d. net.

"Wireless Telegraphy." By Wm. J. White. London: T. C. and E. C. Jack. 1s. net.

"Le Centrali Elettriche degli Stati Uniti d'America." By Elvio Soleri. Rome: Casa Editrice *L'Elettricista*. L 4.

"Telegraphist's and Telephonist's Notebook for 1906." London: S. Rentell & Co., Ltd. 1s. net.

"Projektierung elektrischer Licht-und Kraftübertragungsanlagen. By P. Stierstorfer. Potsdam: A. Stein. M.9.

Johnson & Phillips, Ltd. — This firm have been elected members of the Cable-Makers' Association, and their standard wires will in future bear the official labels authorised by that association.

Catalogues and Lists.—Messrs. Elliott Bros., Lewisham.—New pamphlet (D.C. 64), describing their Model IV. small edgewise moving-coil ammeters and voltmeters for continuous currents.

Simplex Steel Conduit Co., Ltd., Birmingham.—Leaflet stating tables of current prices of their conduit, and particularising some recent additions to their accessories.

Mr. Ernest Roberts, 6, Holborn Place, E.C.—Illustrated price circulars of lampholders, fuseboards, ceiling roses and other electrical accessories.

The A.E.G. English Manufacturing Co., Ltd., London.—16-pp. pamphlet relating to Holophane globes specially constructed for Nernst electric lamps, with various styles of fittings. Excellent illustrations and particulars of prices are given.

Messrs. W. F. Dixon & Co., C-on-M, Manchester.—New circular relating to the Buffalo raw hide silent pinions and gear. Reductions of prices are now notified.

Ateliers H. Cuenod (Soc. An.), Geneva. Illustrated priced circulars relating to Thury automatic regulators, automatic cell switches, alternating arc lamps and electric motors.

India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd., London.—We have received a 20 pp. brochure containing an illustrated account of the Silvertown manufactories of this company, where some 3,000 hands are engaged in the various departments, which as our readers are well aware cover a very wide description of manufacture, from a submarine telegraph cable to electrical measuring instruments and batteries. The gutta-percha department, submarine cable department, electric light department—where electric light cables, dynamos and motors, &c., are produced, and from whence energy is derived for the whole of the works' lighting and power purposes—instrument, carbon and battery department, and the india-rubber departments, are all dealt with, the last-mentioned the most fully of all.

Messrs. Alfred Herbert, Ltd., Coventry.—Section Q of 1906 catalogue, describing and showing half-tone illustrations and tabulated dimensions of their shaping and slotting machines.

Brush Electrical Engineering Co., Ltd.—The Brush Bulletin for March maintains the attractive and breezy reputation which its earlier issues obtained for it. Its avowed object, like that of all well-regulated publicity ventures, is to stir up a spirit of inquiry, and in this it is more than successful. There is something out of the common about this Bulletin which compels you to read, however short of time you may be.

Messrs. S. Wolf & Co., Southwark Street, S.E.—Illustrated leaflet describing their electric grinding machines for attaching to lathe and other rests.

Mr. W. Clark Fisher, West Ealing.—Illustrated price-list of new type mechanical, electrical and scientific high-grade instruments of precision, including dynamometers and wattmeters, galvanometers, deci-millivoltmeters and milliampere-meters, Gordon test set, bridges, rheostats, adaptors, standard resistances, &c.

Messrs. Crompton & Co., Ltd., Salisbury House, E.C.—D 25 list of open-type continuous-current dynamos, containing a full general description with very detailed particulars of outputs, dimensions and weights, also line drawings and half-tone illustrations. Another list (S 7) just issued furnishes equally full particulars relating to the C.B.H. circuit-breakers for continuous current.

Messrs. Ferranti, Ltd., Hollinwood.—Lists numbered 111 and 132 and dated respectively November and December, 1905, particularising and pricing the Ferranti box-type rheostats, and patent water resistance cut-outs.

Messrs. A. Reyrolle & Co., Ltd., Hebburn-on-Tyne.—New illustrated list describing their tank switches of the three-phase oil break type, of which they make a speciality, and which are suitable for use with any class or make of switchgear. A second list gives an illustrated account of the lever type double-pole motor starters and speed regulators. This apparatus includes the firm's special construction of resistance which is without the usual wires, and therefore reduces the risk of failure and stoppages due to faulty operation or overloading which are common to wire resistances. The mechanical construction is also reliable and strong. We understand that there is already an increasing demand for this apparatus as a speed regulator, and also as a double lever motor starter for use in cases where it is specified that the automatic overload release must operate in all positions of the lever during the starting operation. The makers will shortly be able to supply all standard sizes from stock.

A Birmingham Charge.—At Birmingham, on 23rd inst., Francis Joseph Clarke (works manager) and John Troman (foreman) were committed for trial on a charge, already mentioned, of stealing brass and copper scrap, the property of their employers, Messrs. W. Canning & Co., electrical engineers. The metal was sent to a foundry which defendants had themselves opened at Snow Hill, Birmingham.

Brush Contracts.—The following contracts have been booked by the Brush Electrical Engineering Co., Ltd.:—

For the Sunderland Corporation Tramways (per British Westinghouse Co.), six double-deck car-bodies with top covers.

For the Metropolitan Electric Tramways Co., ten double-deck bogie car-bodies.

For the Lancashire United Tramways (per B.T.H. Co.), fourteen double-deck car-bodies with top covers, and four-wheel standard trucks; ten additional trucks.

For the Phœnix Merthyr Coal Co., an 80-kw. dynamo.

Bankruptcy Proceedings.—George Aaron Benton, of Hatherton House, Snareshill, Wolverhampton, formerly of 8, The Exchange, Muswell Hill, Middlesex, electrical engineer, has filed his petition with the Official Receiver for the Wolverhampton district. Debtor estimates his gross liabilities at £1,506 10s. 4d. The assets are estimated to produce £70 14s. 1d., and there is a deficiency of £56 10s. 4d. The causes of failure as alleged by bankrupt are insufficient capital, bad trade, and bad debts.

Arthur Herbert Sparks (A. Herbert & Co., electricians, Holloway). Receiving order made on March 19th on debtor's own petition.

Dissolutions and Liquidations.—The Clift Manufacturing Co., Ltd.—At a meeting of creditors held on 19th inst., the liquidator (Mr. F. C. Harper) reported that Mr. Fryer had consented, subject to all the creditors agreeing, to stand aside so far as his debentures were concerned, until the ordinary creditors had been paid in full, and it was agreed to leave the matter in the hands of the liquidator. The following committee was appointed to assist in the liquidation:—Mr. Frank Nalder (Nalder Bros. and Thompson); Mr. D. Gilson (D. Gilson & Co.); Mr. G. T. Baker (J. H. Tucker & Co.); Mr. A. T. Barnard (Pfeil & Co.).

Auto-Electric Rifle and Target Co., Ltd.—A meeting was held on March 20th, when resolutions were passed winding up the company consequent upon the sale of the undertaking to the New Electric Rifle and Target Co.

Carrington and Button, electrical engineers, 31, High Street, Crewe.—Messrs. C. E. C. Button and G. H. Carrington have dissolved partnership, Mr. Carrington will attend to debts and continue the business.

Motor-Car Exhibition.—Those who wish to see for themselves an up-to-date display of achievements in motor-car construction—particularly heavy vehicles—should endeavour to spare an hour for a visit to the Cordingley Automobile Exhibition which remains open to-day and to-morrow, at the Agricultural Hall, Islington. This is Cordingley's eleventh annual show, and it contains a very fine collection of all classes of motor-vehicles, frames, bodies, equipments and accessories. Electrical vehicle exhibits could be counted on the fingers of one hand, but there are a goodly number of displays of ignition and other electric devices

as usual. The Krieger Electric Carriage Syndicate, Ltd., are showing their front-wheel driven electric landaulets, coupés and victorias; the Improved Electric Traction, Ltd., of 17, Cockspur Street, S.W., show an electric delivery van and a brougham; Messrs. Savage Bros., of King's Lynn, show a 5-ton steam wagon with a 9½-KW. direct-coupled electric plant, for municipal and other contracting work. Motor-'buses, heavy steam wagons, motor-boats, a Crossley gas-driven electric lighting set and suction gas plant to drive it, are prominent features of interest to the visitor. "Sunbeam" electric light baths are exhibited by Mr. C. M. Holmquist; the Prested Miners' Gas-Indicating Electric Lamp Co. show their ignition batteries, coil plugs, electric safety lamps for use in petrol houses, measuring instruments, and so on; the Accessible Battery and Engineering Co. show accessible ignition batteries charging apparatus; R. Waygood & Co., Ltd., show their electric lifts; Messrs. J. C. Fuller & Son, of Bow, exhibit their ignition apparatus, electrical garage equipments, house-lighting sets, &c.; Messrs. S. Smith & Son, Ltd., are present with their speed indicators, electric communicators, &c.; and so we might go on to the extent of a column.

Trade Announcements. — Mr. Douglas Wells, M.I.E.E., of Brussels, has been appointed sole agent in Belgium, Holland, and Luxemburg by Messrs. Ed. Bennis & Co., Ltd., of Little Hulton, Bolton, for their patent machine stokers and other specialities.

Following our "Personal" note last week respecting Mr. H. N. Howlett, we are asked to state that Mr. C. W. Howlett has also severed his connection with Mr. G. Braulik, and has taken up a position with Messrs. G. Straus & Co., Ltd.

Messrs. Turner & Hudson, of Ivy Street, Hoxton, N., have issued a circular letter giving wholesale prices of whitewood casings.

Messrs. Joseph Clayton & Sons, of Chesterfield, well known as manufacturers of leather for machine belting, have opened a factory for the manufacture of machine belting, fire hose, pump, cup, and hydraulic leathers. They have issued a price list of chrome-tanned leather which is specially recommended for dynamo-driving. The firm's London agents are Messrs. James Holmes, Ltd., 46, Grange Walk, Bermondsey, S.E.

The Patent Indented Steel Bar Co, Ltd, has been formed for supplying a bar of special section for reinforced concrete construction. The features of the bar are great adhesion to the concrete owing to the mechanical bond formed by its indented surface, and a constant section, thus utilising the full sectional area in resistance to stresses. This bar has already been employed abroad on a considerable scale in concrete work. The company have taken offices in Queen Anne's Chambers, Westminster, S.W.

Messrs. William C. Yuille & Co. have removed to 60, Brown Street, Anderston, Glasgow.

Messrs. W. Sisson & Co., Ltd., engineers, Gloucester, have appointed Messrs. Agnew & Donaldson, of 25, Victoria Street, S.W., to represent them in the London district. Any inquiries relating to their specialities, viz., high-speed enclosed self-lubricating engines and marine machinery may be sent either to the latter or direct to Gloucester.

Messrs. D. Santoni & Co., Ltd., have now removed to the modernly-equipped works and testing laboratories that they have erected at the Alba Works, 15/17, Beauchamp Street, Brook Street, Holborn, E.C. Here they will have the advantage of better accommodation to meet increasing business, and a special staff engaged upon the Santoni intense flame arc lamps, while the needs of electric railway and tramway work in such matters as indicating apparatus, accessories and spare parts will be specialised in.

Tramcar Brakes.—The British Westinghouse Co. has received an order from the London County Council for 334 brake equipments for as many cars, making in all 400 L.C.C. cars which will be equipped with the Westinghouse magnetic brake when this contract is completed.

Pulling v. Earle.—In the Court of Appeal defendant applied for judgment on a new trial on appeal from verdict and judgment in favour of the plaintiff for £470, at trial before Mr. Justice Walton and a special jury. Plaintiff claimed against the defendant (a solicitor at Manchester) for damages for alleged negligence in advising him to invest in stock of the South Lancashire Electric Traction and Power Co., the investment turning out unfortunately for the plaintiff. Defendant was an underwriter of the stock. The only point in the case was whether the defendant had acted negligently. After counsel's arguments, the hearing was adjourned.

A Fiftieth Anniversary.—We have received from the London agency of Dr. Heinr. Traun & Sons an illustrated brochure giving the history of their factory, which was compiled for distribution on the occasion of the 50th anniversary of the founding of the firm. The celebration of this event took place in Hamburg on February 17th, the firm having invited about 400 guests to a banquet, and afterwards about 4,000 people (workmen and their friends) were present at a concert and ball. On that occasion Senator Dr. Traun divided £5,000 amongst his workmen. The publication contains a good deal of interesting information, and many excellent photographs of the present and past leading spirits in the firm, and of the different departments at the factories.

Leek Lighting.—A L.G.B. inquiry was held on March 20th relative to the application of the U.D.C. for a loan of £4,724 for E.L. extensions.

LIGHTING and POWER NOTES.

Ashton-in-Makerfield.—The U.D.C. has circularised the ratepayers, with the object of ascertaining the probable number of E.L. consumers if the Council established a supply. Out of 612 circulars sent out, 486 were not returned, 39 were in favour of taking a supply for light, 4 offered to become power consumers, and 1 if permitted to hire or purchase a motor at Manchester rates, 2 were in favour of the light subject to free fittings, and 79 were against a supply of current. The B. of T. last September deferred for the last time the consideration of the revocation of the order.

Bargoed.—The Gilfach Chamber of Trade has decided to oppose the Gellygaer U.D.C.'s E.L. scheme.

Bridlington.—The L.G.B. has sanctioned the borrowing of £5,580 for extensions to the electricity works. In view of the short term for which the loan has been granted, 16 years, the Corporation has appointed a deputation to interview the President of the L.G.B.

Burnley.—A new 500-KW. set, just put down by Messrs. Dick, Kerr & Co. at a cost of £2,925, was started on Saturday last. This addition forms the eighth set installed, and brings the total capacity of the works up to 2,000 KW.

Carrickfergus.—The U.D.C. has accepted an offer of Messrs. Curran Bros., Belfast, to erect and maintain for five years a system of electric light for the town, and has instructed the Lighting Committee to draw up an agreement.

Continental Notes.—Italy.—A concession has been granted for the erection of a hydro-electric plant on the River Agazzo at Prato Carnico, to supply energy for lighting and power.

La Societa Co-operativa Elettrica is to erect an electricity works at Novi for lighting the town.

Another company has been formed at Milan with a capital of £12,000, to develop certain water-power in the generation of electrical energy.

Powers have been asked to put down a water-power plant on the River Tiber to supply the energy required for the operation of the Civita Castellana electric tramway.

A company has been registered at Valleggio, with a capital of 55,000 lire, to undertake the electric lighting and distribution of energy in the neighbourhood.

Messrs. Marcantoni & Torresi have obtained a concession from the Prefecture of Ascoli Piceno for obtaining water-power from the River Aso, to be utilised in electric lighting between Porto San Giorgio and Grottammare, on the Adriatic coast.—*Board of Trade Journal.*

Russia.—The municipal authority of Zarizyn-on-the-Volga is open to receive offers for the electric lighting of the town, together with the operation of an electric tramway.

Germany.—Tenders are to be invited for the establishment of an electricity works at Ziesar (Saxony).

Portugal.—A decree is issued approving a contract entered into between the municipal authority of Angra do Heroismo and S. V. B. Vasconcellos e Lemos, for the lighting of the town by electricity.—*Board of Trade Journal.*

Austria.—The Fiume municipality is about to erect a hydro-electric generating station at a cost of 2,200,000 crowns.—*Board of Trade Journal.*

Dublin.—In his annual report on the finances of the Corporation, the L.G.B. auditor comments on the action of the E.L. Committee with regard to certain contracts, as irregular, unfair to other competing firms, and calculated to defeat the beneficial advantages intended to be secured for ratepayers by the statutory provision requiring advertising for tenders. Two tenders were recommended for acceptance much in advance of the lowest, and subsequently a third, which had been double the lowest, was accepted when somewhat reduced. The auditor points out that no provision has been made towards depreciation for electrical plant since 1895, and urges the setting aside of a substantial sum annually, particularly as the change over to the new generating stations resulted in a loss of £25,500, for which no asset remains. The paying off of this outstanding balance of loan should be discharged in seven years from that date. The Committee adopted the recommendation, but the Council, on the advice of the Estates and Finance Committee, has declined to give effect to it.

The scheme for the electric lighting of Clontarf is shortly to be proceeded with, and comprises the erection of about 50 or 60 public arcs in addition to a private supply. The Corporation is erecting a sub-station at Clontarf, the energy being supplied from the Pigeon House station. The probable cost of the scheme is £28,000-£30,000. It appears that the Corporation has somewhat reluctantly commenced this extension to its system, it being the outcome of proceedings instituted by Clontarf under the Boundaries Act, under which the Corporation took over the prov. order.

Eston.—With the approval of the B. of T., the U.D.C. has decided to transfer its E.L. order to the Cleveland and Durham County Electric Power Co., the consideration being £223.

Golcar.—The U.D.C. has granted permission for the Huddersfield T.C. to lay E.L. cables to supply Wellhouse and Crimble.

Hoylake and West Kirby.—The report of the working of the U.D.C.'s electricity undertaking for the past eleven months shows a profit of £328.

India.—Mussoorie.—The Government reply to the Municipal Board's recommendation of the Brush Electrical Engineering Co.'s tender is as follows: The Board recommends the acceptance of the tender of the Brush Co., whereas the electrical adviser to the Government of India recommends that of Messrs. Bruce Peebles & Co. The Lieutenant-Governor accepts the recommendation of the electrical adviser, and sanctions the acceptance by the Municipal Board of Mussoorie of the tender of Messrs. Bruce Peebles & Co. The Board before giving the contract to this firm should see to the points raised by the electrical adviser in his note discussing the tenders. In accordance with these orders the Board had no alternative but to give Messrs. Bruce Peebles the contract, and a letter has been dispatched to them stating that their tender has been accepted.—*Indian Engineering.*

Lancashire Collieries.—The Westhoughton Coal and Cannel Co. has recently installed three-phase motors for pumping and ventilating purposes. Energy is taken from the Lancashire Electric Power Co.'s transformer chamber, erected on the colliery company's premises.

London.—Marylebone.—The Electric Supply Committee reports that the net revenue account of the Council's electricity undertaking shows for the nine months ended December 31st last, a debit balance of £3,264.

L.C.C.—It has been resolved to lend £12,100 to the St. Pancras B.C. for purposes in connection with the E.L. undertaking.

Stepney.—The Lighting Committee has decided in favour of offering an alternative rate for energy supplied to large long-hour consumers; for lighting, 5s. per 8-c.p. lamp demanded per annum, and $\frac{9}{10}$d. per unit for all electricity consumed; and for power and all purposes other than lighting, 5s. per h.p. demanded per month and ½d. per unit for all energy consumed. Prepayment meters are to be introduced into the borough. An L.C.C. loan of £10,000 in connection with the extension of the power house in Osborn Street has been taken up.

Maidstone.—From April 2nd to 7th, an electrical exhibition is to be held in the town under the auspices of the Corporation. It is to be opened by the Mayor, and admission is to be free.

Mexico.—Application has been made to the Mexican Government for a concession to put down a plant to utilise the water-power of the Rive Grande de Curcatlan, at Tecomaxtlahua (Oaxaca) for electrical purposes.

The Government has granted a concession to put down a hydro-electric plant on the River Aros, in the Sonora district.

Application has been made for a concession to utilise the water power of the Frio River, to generate electrical energy.—*Board of Trade Journal.*

Northampton.—The E.L. and Power Co. has decided to give consumers the option of a flat rate of 5d. per unit from Midsummer, in place of the present rates of 6d. and 3d. For power, the charge is to be 2d. with discounts on a sliding scale up to 20 per cent. All the rates are subject to a discount of 5 per cent.

Oldham.—A communication has been received by the Electricity Committee from the L.G.B., anent the recent inquiry for further borrowing powers in connection with its undertaking. The Board has decided to sanction the borrowing of £1,946 for special items in addition to the £32,432 already sanctioned, but finds "no sufficient reason for varying its (the Board's) decision regarding other items in the Council's application." The items disallowed in the first instance amounted to £10,213, but, in addition to that, there is a sum of £2,267—representing a portion of the expenditure at RhodesB ank—which the L.G.B. considers must be refunded and paid out of moneys previously sanctioned. In all, there is a total of £7,800 which has to be found out of the Committee's funds.

Ormesby.—The U.D.C. has published a notice of its intention to transfer its prov. order to the Cleveland and Durham County E.P. Co.

Penrith.—The Electricity Committee of the U.D.C. has decided to ask the B. of T. not to revoke the E.L. order, which has not been carried out "because the time is inopportune owing to the numerous other things to be done."

South Africa.—Ladybrand.—Before coming to any decision on the question of lighting the town by electricity, the T.C. has agreed to ascertain from Potchefstroom and Winburg the cost of working, &c.

Bethlehem.—The inauguration of the electric street lighting recently took place.

Dalmeny Estate (Natal).—The new pleasure resort on the banks of the Umlass River, is to be lighted by electricity, the power being generated from the three waterfalls on the estate, which are also to be utilised to pump water to the houses in the township, as well as for supplying the power for a system of electric cars to the station, six miles distant.

Pretoria.—The Mayoral Minute for the year 1905 includes the report of Mr. T. C. Wolley Dod, manager of the Pretoria Municipal Electric Supply Department, who states *inter alia*:—"During the year the whole of the incandescent lamps with one or two exceptions, were changed for Nernst lamps, and about five miles of streets in Sunnyside and Arcadia were lighted by Nernst lamps, and provision has been made for lighting 2½ miles of streets in the western portion of the town. The street lighting, as above, amounts to 80 arc lamps, 130 Nernst lamps, and five incandescents. The number of units sold for the 10 months was, for lighting, 717,263; for power, 98,766; total, 816,029. The total revenue from electric supply was £36,088.

Stourbridge.—The U.D.C. has referred the draft agreement for the transfer of the Council's electrical powers to the Shropshire Electric Power Co., to the Electric Powers Committee for further negotiations, and reports that the Council is dissatisfied with the terms of the re-purchase clause in the agreement.

U.S.A.—New York.—The savings on the tenders for the city electric street lighting for 1906 over those quoted in 1903, are very considerable, as the following will show:—

Boroughs.	1903.	1906.
Manhattan	£98,265	£67,736
Bronx	58,718	45,454
Brooklyn..	118,237	91,969
Queens	57,472	43,104
Richmond	32,765	29,815
	£366,457	£278,078

The tenders for 1904 and 1905 were never accepted, owing to litigation. The reduction in prices has led the Mayor to withdraw his advocacy of a municipal scheme. The rate per 2,000-c.p. arc has been reduced from £25 4s. to £15. The New York Edison Co. has now 1,657,408 16-c.p. lamps contracted for in Manhattan.

California.—The plan to develop 400,000 h.p. for the generation of electricity on the Feather River, Northern California, will involve an outlay of £10,000,000. Power will be supplied to all the towns in the Sacramento Valley, and two-pole transmission lines will be run 175 miles into San Francisco. Hydro-electric energy is already extensively used throughout the State. The California Gas and Electric Corporation carries electric power from Colgate to Oakland, around the Bay of San Francisco, a distance of 219 miles.

Wallasey.—Extensions have been decided upon by the electricity department at the U.D.C.'s generating station. New boilers are to be put in, and a 500-kw. steam alternator installed.

Walmer.—The U.D.C. has been informed by its adviser that it will probably find a difficulty in obtaining a company who would offer satisfactory terms at the present time for working the E.L. order. Messrs. Edmundson's Electricity Corporation has intimated that it is not prepared to deal with the order, as the B. of T. and the L.G.B. would not now sanction the agreement outlined in 1901. Messrs. Foote & Milne have offered to submit a proposal. The Council has decided to inquire whether it is now practicable for a company to work the order under a lease or otherwise.

Waterford.—After further considering the matter, the Corporation has resolved not to oppose the application of the National Provincial Electricity Corporation for an E.L. prov. order for the town.

West Bromwich.—The Electric L. and P. Committee has recommended that £800 be put to the relief of the rates from the profits of the electricity undertaking.

Willesden.—Draft forms of agreement for the hiring and hire-purchase of motors have been approved by the U.D.C. The electrical engineer has submitted a scale of charges for large power consumers. For each h.p. demanded, 15s. per quarter is to be charged, and the price per unit is to vary from 9d. to firms consuming not more than 4,700 per quarter to 5d. to firms consuming over 50,000 per quarter. The total charge is in no case to exceed 1½d. per unit.

TRAMWAY and RAILWAY NOTES.

Altrincham.—The B. of T. has granted the U.D.C. a prov. order to construct electric tramways in the town.

Bournemouth.—A public inquiry was held at Bournemouth on Monday last by the Light Railway Commissioners, respecting an application for an order for the construction of a light railway from Bournemouth to Swanage, *viâ* Branksome Park, and across Poole Harbour by means of a conveyor bridge. After hearing the case for the promoters, the Commissioners decided, in view of the strong local opposition, that they were not justified in granting an order.

Chorlton.—The Manchester Council has acquiesced in the proposal to include the cost of laying tramlines in Manchester Road and Barlowmoor Road in the estimates, thus carrying the tramway service through the Chorlton district, at a probable cost of £12,000.

Continental Note.—Switzerland.—The steam railway in the Birsig Valley has recently been transformed to electrical working. The coaches, each fitted with four motors, are 15½ metres in length, and take a supply of direct current at 750 to 1,000 volts. Power is generated at 6,500 volts three-phase, 50 cycles, and is transmitted a distance of 5 km. to the sub-station at Obervil, where there are two converters each of 150 h.p., and a battery of accumulators of 250 ampere-hours capacity.

India.—It is announced that the gauge of the projected Rawalpindi-Murree Electric Railway is changed from 2 ft. 6 in. to 1 metre; the length of the line has been reduced, so that the capital outlay remains unaltered, the share capital being

Rs. 50,00,000 in shares of Rs. 100 each, with power to issue debentures. The concessionaire is Mr. James Brown, of the Murree Brewery Co., Rawalpindi.

London.—Metropolitan Railway.—The guards and conductors on the Metropolitan Railway have been ordered to clean out the electric carriages. The men are arranging to hold a meeting to protest against the "indignity" to which they have been subjected.

New Outer Circle Railway.—A Bill is before Parliament for the construction of a new electric railway, 40 miles in length, destined to run between Feltham and West Ham (Royal Albert Docks), and called the London Outer Circle Railway. The engineers' estimate for the constructional work is £3,320,000, but at least £5,000,000 will have to be expended before running operations are begun. The company proposes to proceed with the work as soon as the necessary powers are granted.

Metropolitan District Railway.—Delay was caused early on Thursday morning last week by the derailment at the Minories Junction of a car of an electric train proceeding to East Ham. A train proceeding in an opposite direction was passing, and before it could be brought to a standstill three or four of the cars in the centre scraped the corner of the derailed car. Very little damage was done to the rolling stock, but up to nine o'clock the line was blocked.

L.C.C.—Captain Hemphill, in reply to questions, recently stated that the Highways Committee had decided in favour of extending the electric tramways from the Angel, Islington, to the Cock, at Highbury. The tramways from Mare Street to Hackney would be proceeded with as soon as possible.

The estimates for capital expenditure on tramways and electric supply in the financial year ending March 31st, 1907, have been prepared by the Highways Committee. On the southern system, including projected lines in West London, it is calculated that the total expenditure will amount to £725,500, while on the northern system the outlay comprises £436,000 for the acquisition of the undertaking of the North Metropolitan Tramways Co., and £942,223 for reconstruction works, the provision of rolling stock and sub-station machinery. The amount for power stations is put at £130,302. These make a total of £2,291,025 for the year. In addition to this the estimates include £2,000,000 for the construction and equipment of new tramways in the Bill now before Parliament, the sum in question embodying £50,000 for electric supply purposes provisionally in the acquisition of land, erection of stations and laying of mains.

Manchester.—On Monday a conference lasting three hours took place between the Manchester tramway men's representatives and a sub-committee of the Corporation, with regard to the question of payment for Sunday labour. The result was that the men waived any demand except that of payment of time and a half rates for all Sunday labour; the offer of the Tramways Committee of time and a quarter for overtime was withdrawn, and the dispute is to be submitted to arbitration. The sub-committee expressed its willingness to recommend the General Committee to make the following offer: "If the men's Association are willing to bear the costs of the arbitration in the event of the award not being in the men's favour, to refer to an arbitrator to be appointed by the B. of T. the question as to whether or not the drivers and guards are reasonably entitled to payment at the rate of time and a half for all Sunday labour, having regard to the concessions granted by the Committee in the past, to the present wages and working conditions of the men as compared with the wages and working conditions obtaining in other tramway undertakings, and to such other facts and arguments as may be submitted for or against the proposal; also, if the majority of the men agree to be bound by the decision." The condition of the ballot was not agreed to by the men because there were a number of men employed who were not members of the men's Association. Those men would gain by any concession which was got by arbitration, but they would not have to participate in the cost in the event of the men losing.

The Committee has since agreed to delete the condition of a ballot among the whole of the men, so that the way is clear for arbitration on the Sunday labour question. The tramway men have expressed their willingness to stand or fall by the arbitrator's decision, and to pay the cost of the arbitration should they fail.

Middlesex.—Under the agreement between the County Council and the Metropolitan Tramway and Omnibus Co., now the Metropolitan Electric Tramway, Ltd., the County Council has to pay the company the costs, charges and expenses of and incidental to the preparation, making and confirmation of the order. The engineer employed by the company made a claim of £6,779 under this agreement. The matter was referred to arbitration, and the decision of the arbitrator, reported to the Council on Thursday of last week, was that he awarded the engineer £1,916 and costs, which he assessed at £606, each party to bear half the cost of the award, which he assessed at £345. The County solicitor has been directed to appeal to the B. of T. against the refusal of the Light Railway Commissioners to grant the application of the County Council for powers to construct a light railway from Edgware through Stanmore to the Middlesex and Hertfordshire county boundary. Application is to be made to the B. of T. for an extension of time in which to complete the work authorised by the County of Middlesex Light Railway Order, 1903. The County of Middlesex (Waltham Cross and Enfield) Light Railway Order, 1906, has been approved in the form in which the B. of T. proposed to confirm it.

Newcastle-on-Tyne.—The estimates for the Corporation tramways show that in 1905 the Committee estimated to spend £205,239, but actually spent £191,280. The estimate for 1906 was £188,744, which did not include depreciation and renewals. The amount required for the ensuing twelve months is set down at £182,800, also excluding depreciation and renewals. Of that sum £60,000 is required for traffic expenses and £19,000 for general repairs and maintenance. The estimated income is put down at £202,000, giving an excess over expenditure of about £19,000.

Oldham.—As the result of the working of the Corporation electric tramways from March 25th, 1905, to March 18th, 1906, the receipts totalled £82,830, being an increase of £18,240 on the previous year. The average earnings per car-mile have advanced from 10·46d. to 11·54d. In the number of passengers carried there has been an increase of 3,127,315. The wages paid were equal to 3·06d. per car-mile, against 3·03d.; the electrical energy consumed was 1·85 units, against 1·72 units; whilst the average receipts per passenger were 1·19d., as compared with 1·26d. twelve months ago.

Penarth.—Messrs. Lewis & Fletcher, electrical engineers, Cardiff, propose to make application to the B. of T. for powers to construct a tramway between Penarth and Cardiff.

Rochdale.—The Corporation tramway workers at Rochdale have sent a request to the Tramways Committee for time and a quarter for Sunday labour; that time worked over and above 10 hours in any day be paid for at overtime rate; and that they be allowed one week's holiday per year, with pay.

Salford.—The Salford Tramway Committee has received a request from the tramway men for an advance from 6¾d. to 7d. per hour, the rate at present obtaining in Manchester. There are about 250 drivers, and the same number of conductors, and the increase, if allowed, will mean at least £1,000 per year. At present the Salford men are paid ½d. per hour extra for Sunday labour.

South Africa.—Johannesburg.—A start has been made with the running of the electric trams. On February 14th the section from Fordsburg to Market Square was opened to the public. The subject of dealing with coloured passengers has been engaging the attention of the Council; it is decided that for the present three back seats on the top deck be allotted to such passengers, and if the traffic later on warrants it, trailers may be introduced.

Cape Colony.—An Act enforcing the use of life guards, to be approved by Government, comes into force on August 1st next. A vertical board, or other arrangement, capable of merely thrusting aside obstacles will not be considered efficient.

U.S.A.—New York City.—Dr. George A. Soper has reported that the atmosphere of the subway is good, but that there are more pneumonia germs there than in the outside air. He severely criticises the filthy condition of the stations and cars. Recent inquests on subway employés show that the air is charged with minute steel particles, and Dr. Soper is quoted as saying that the wear on the rails amounts to one ton of steel dust per mile per annum. Mr. Herbert W. Hart, an English engineer, avers that the rails are improperly gauged. Regarding new subways, the N.Y. *Tribune* prophesies that Mr. August Belmont will under-bid any possible rival by £1,600,000 on account of the present subway power plant being designed to supply enough power to operate three or four lines. The "merger" of the Belmont and Ryan traction systems has been completed, and has been declared legal. The new company—the Interborough-Metropolitan—which will hold the stocks of the combined companies, has increased its capital from £3,000 to £31,000,000. On March 4th fire destroyed the car-sheds of the Metropolitan surface line on 42nd Street, doing damage estimated at £50,000; and on March 10th another fire did damage to the amount of £15,000 at the Eighth Avenue barns. These structures will be rebuilt, and the power house on 129th Street is to be enlarged and improved at a cost of £30,000.

New York, New Haven and Hartford Railroad.—This railroad will change its terminal from the Grand Central Station, New York City, to the new Pennsylvania Railroad terminal on 34th Street when completed. The New Haven engineers have commenced to convert the suburban lines from steam to electricity, and have sent several cars to the Westinghouse shops at Pittsburg, Pa., for equipment with electric motors. The underlying cause for the change of terminal is said to be a difference of opinion as to the use of A.C. motors between the engineering staff of the N.Y. Central and New Haven companies.

Omaha, Neb.—The Union Pacific and Southern Pacific Railroads have given an order for automatic electrically operated block signals for 2,342 miles of track from Omaha to San Francisco and Los Angeles. The equipment will cost about £600,000.

West Ham.—The borough treasurer on Tuesday reported that he estimated that the surplus available from the tramways undertaking for the year ending the 31st inst. would amount to £15,000. He recommended that £8,000 of this should be given in aid of the borough rate and the balance should be placed to the credit of the reserve fund. The report was adopted.

Telegraph Rates.—According to *l'Elettricista* of Rome, for January 19th last, arrangements are being completed between France, Great Britain, Austria and Italy, whereby a reduction of 50 per cent. will be effected on Press telegrams that are handed in for transmission between 6 p.m. and 9 a.m.

TELEGRAPH and TELEPHONE NOTES.

Automatic Telephony.—It is stated that a syndicate has secured the British patent for the "Lorimer" system of automatic telephony.

Fanning Island.—The Press this week announced that Fanning Island is to be disposed of by auction to any willing purchaser on the 17th prox., together with Washington Island. It appears that the owners by possession of the islands are bankrupt, and are, therefore, desirous of selling them. Although, apparently, the British Government does not mind the acquisition of Fanning Island by other than British subjects, it has provided that the buyer must remain a Crown tenant. As the British Pacific cable lands on Fanning Island, the best thing the Government can do is to purchase the island itself.

France.—During the Presidential election in France, special arrangements were made between Paris and Versailles to secure the rapid transmission of the result. The French Administration provided 32 additional Baudot and 20 Hughes keys and 35 telephone circuits. In the space of three-quarters of an hour 92,000 words were sent, and the result of the election was known 10 minutes after its declaration.

German Telephones.—The German telephone system is to be greatly extended during the present year by the creation of 20 new local systems. The length of aerial line to be erected will be 710 kilometres, and the wires will be 64,766 kilometres in length, of which 6,555 kilometres will be bronze wire of 2 mm., and the remainder of the same quality of 3, 4, 4·5 and 5 mm., or of copper. The most important lines to be constructed are those between Berlin, Bremen, Dresden, Danzig, Mainz, Munich, Hannover, Breslau and Magdeburg; between Breslau and Magdeburg, Cologne and Nuremberg, Breslau and Stettin, Frankfort-on-the-Maine and Hamburg, Hamburg and Stettin, Magdeburg and Stettin, and Hamburg and Rotterdam. The cost of these lines is estimated at 18,375,000 fr.

Panama.—The construction and operation of a military cable, to be opened for commercial purposes between Key West, Guantanamo, and the Canal zone, have been authorised. A maximum rate of 40 c. a word is to be charged.—*Board of Trade Journal.*

Portsmouth.—The L.G.B. has sanctioned the expenditure of £18,000 upon an extension of the municipal telephone system.

Post Office Servants.—The Select Committee of the House of Commons which is inquiring into the Postal service sat last week, and Mr. Babington Smith, Secretary to the G.P.O., gave evidence. Comparing 1905 with 1885, he said the increase in wages for the same number of officers was 1¼ millions sterling, representing an advance of 55½ per cent. in the case of male telegraphists at the Central Telegraph Office, 13 per cent. in the case of female telegraphists, 31½ per cent. and 26¼ per cent. respectively in the case of male and female counter clerks and telegraphists. The advances had been out of all proportion to the rates of increase in other callings, as shown by official returns, and the witness showed by the numbers of candidates, the efficiency of the workers, and the fewness of resignations, that the Post Office pay was attractive. Sick leave, holidays, and other advantages represented substantial additions to the nominal cash wages.

Postal Union Congress.—The Postal Union Congress, which has been twice postponed, will open at Rome on April 7th next. The Postmaster-General has appointed as delegates of the United Kingdom and various British Colonies Mr. Henry Babington Smith, C.B., C.S.I., Secretary to the Post Office, Mr. Arthur B. Walkley, principal clerk in the Secretary's Office, and Mr. Henry Davies, I.S.O., Chief Examiner in the Accountant-General's Department. Mr. Arthur G. Ferard, Principal Clerk for Foreign and Colonial business, will accompany the British delegation as secretary, and Mr. E. J. Harrington, of the Accountant-General's Department, as an attaché.—*Times.*

Swansea.—The Corporation has been taken aback by the offer of the Postmaster-General of £17,000 for the municipal telephone system, which has cost £26,961. The Telephones Committee thought the offer ridiculous. According to the *Western Mail*, it had the fixed idea "that there should be no loss to the town by the transfer." The P.M.G. stated that a deduction would have to be made for depreciation; that the Corporation exchange building must be omitted, as it would probably be of no use, and that 60 per cent. of the cost was, in his opinion, a liberal offer.

Wireless Telegraphy.—The Hamburg-American liner *Deutschland* has made a new record during her voyage from New York, wireless telegraphic messages having been exchanged with the station at the Lizard at a distance of 2,000 miles continuously.

The Marconi Co. intimates that, if circumstances permit, telegrams will, without additional charge, be transmitted to the first outward bound vessel passing the shore station for re-transmission by such vessel to the incoming vessels to which they are addressed. Telegrams so dealt with will subsequently be confirmed by the shore station.

According to *l'Eclairage Electrique*, the de Forest Wireless station at Coney Island has been able to communicate with the stations at Galveston and New Orleans, the distance overland being 1,900 kilometres. The same distance was also covered by a message between Colon and Key West during the night, but it was impossible during the daytime. Communication also was only possible during the night between the stations at Manhattan Beach and San Juan and Key West.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Port Arthur-Chifu (Closed)	Mar. 7, 1904	
Jamaica-Colon	Jan. 5, 1905	
Cadiz-Tenerif	July 20, 1905	
Tarifa-Tangier	Jan. 18, 1904	
Puerto Plata-Martinique	Oct. 30, 1905	
St. Vincent-St. Lucia	Feb. 16, 1906	
Tangier-Cadiz	Feb. 18, 1906	
Landlines.		
Puerto-Barrios	Aug. 28, 1902	
Communication with Brazil *via* Galveston	July 18, 1905	
Bachkale-Deliman	Feb. 12, 1906	

CONTRACTS OPEN and CLOSED.

OPEN.

Aston.—April 2nd. Telephone installation for the Workhouse Buildings, Grayeley Hill, Birmingham. W. H. Whitehouse, Consulting Engineer, 37A, Waterloo Street, Birmingham.

Belfast.—April 16th. Coal and ash conveying plant, bunkers and chain-grate stokers. See "Official Notices" March 23rd.

Belgium.—April 19th. The municipal authorities of Couvin are inviting tenders for the concession for the public and private electric lighting of the town. Particulars may be obtained from, and tenders are to be sent to, Le Secretariat Communal, Couvin, Belgium.

Belgium.—The *B. of T. Journal* for March 22nd contains a notice of a contract, open until June 1st next, for supplying electricity to the town of Luxemburg for lighting and traction.

Chester.—March 31st. Construction and electrical equipment of tramways (permanent way, bonds, and overhead equipment) for the Corporation. See "Official Notices" March 9th.

Dover.—April 2nd. Surface condenser and Edwards air pump for the Electricity Department. See "Official Notices" March 23rd.

East Indian Railway.—An indent for transformers and other materials for the electrical equipment of the transformer house at Howrah has been sanctioned at a cost of about Rs. 23,000. —*Indian Engineering.*

Exeter.—April 11th. Overhead equipment for ⅝ mile of tramway route. See "Official Notices" to-day.

Glasgow.—April 4th. Stores and fuel for the tramways department. Specification, &c., from Mr. J. Dalrymple, General Manager, 46, Bath Street.

Greenock.—April 6th. The Greenock and District Combination Hospital Board invite tenders for (1) electric lighting; (2) electric lifts; (3) telephones and e'ectric bells for new combination hospital, in course of erection. John Dixon, A.M.Inst.M.E., consulting engineer. Particulars from Colin MacCulloch, Clerk to the Board, Municipal Buildings, Greenock (one guinea, returnable).

L. & Y. Railway.—April 2nd. Stores for 12 months, including signal and telegraph fittings, also signal, telegraph and electric light wires. Mr. Duffin, Stores Department, Osborne Street, Manchester.

Leeds.—April 9th. Steam turbine, two-phase alternator and exciter (3,000 KW.), condensing plant and piping, for the electric lighting department. See "Official Notices" February 23rd.

Portsmouth.—April 10th. Stores, &c., for the Corporation. See "Official Notices" March 23rd.

Roumania.—April 25th. Tenders for the Municipality, Turnu-Severin, for a concession to supply that town with electric light. Plans, specifications, &c., at the Municipal offices.—*Board of Trade Journal.*

St. Pancras.—Tenders are to be invited for materials for the installation of the electric light in the Workhouse buildings. The estimated cost of the work is £500.

Salford.—April 21st. One 750-KW. steam turbo-generator and condensing plant. See "Official Notices" March 23rd.

Spain.—Applications have been received from :—(1) The Biscay Electricity Co. for the concession of a tramway in Bilbao; (2) the San Sebastian Tramway Co. for the concession of two electric tramways in San Sebastian. Up to April 12th is allowed for other proposals on more favourable terms, duly guaranteed, to be made.—*Board of Trade Journal.*

Spain.—The *B. of T. Journal* for 22nd inst. contained notices of contracts open for an electric tramway concession in Madrid, and eight electric cranes for Huelva.

Sunderland.—April 4th. Steam, &c., piping for Hylton Road station extensions. See "Official Notices" March 23rd.

Sunderland.—March 30th. One 750-KW. three-phase steam alternator, one 300-KW. static transformer, and two portable air compressors for the electricity department. See "Official Notices" March 9th.

Wallasey.—April 18th. Boilers, 500-KW. steam alternator (single-phase), also extensions to electricity works buildings, for the U.D.C. See "Official Notices" March 23rd.

Warrington.—April 10th. Earthenware ducts for the Electricity Department. See "Official Notices" to-day.

CLOSED.

Cardiff.—The T.C. has accepted the tender of Messrs. Balcke & Co., of London, for the supply of a cooling tower at the power station, at £2,440.

Canterbury.—The T.C. has accepted the tender of the Chloride Electrical Storage Co. for a Highfield semi-automatic booster, at £269.

Cape Town.—The following tenders were received for the wiring of the offices in connection with the new Cape University Building :—

Cunningham & Gearing	£223	Green & Trevett ..	£357
Geo. Findlay & Co. ..	272	Koch & Dixie	413
Clyde Engineering Co.	350		

The wiring is to be carried out in galvanised wire duct. The supply and fixing of fittings is not included in these tenders.

Chatham Dockyards.—The Lords Commissioners of the Admiralty have just placed with the British Thomson-Houston Co., Ltd., of Rugby, an order for five 5-H.P., ten 10-H.P. and two 50-H.P. motors and rheostats for use in the Chatham Dockyards.

Glasgow.—Messrs. Witting, Eborall & Co., Ltd., of Temple Bar House, E.C., inform us that the Glasgow Corporation has placed in their hands the construction of all the additional high pressure switchgear required in connection with the extensions to the Port Dundas power station, and amounting to nine completed and 10 blank panels. This practically doubles the capacity of the original portion of the board, also executed by Witting, Eborall and Co., Ltd., and the whole board when completed will control and distribute energy at 6,600 volts from the 3,000-KW. three-phase generating plants, whose total capacity will eventually be 20,000 KW. The value of the work already done and in hand is approximately £10,000.

Lancaster.—The Electricity Committee has accepted the tender of Callender's Cable & Construction Co. for cables and mains. The tender of Messrs. Green has been accepted for the renewal of one section of the economiser.

Leyton.—The U.D.C. accepted the following tenders on Tuesday :—

Callender's Cable & Construction Co., Ltd., underground feeders.
Stan. Zylberlast, condenser water cooler.

London.—The following is a list of tenders submitted for certain electrical work at 22 and 23, Fenchurch Street, E.C. The difference between the highest and lowest quotations leads one to think all sorts of things :—

Partington & Co...	£148	Strode	£131
Durell	140	Allam (accepted)	89

BATTERSEA.—The B.C. has accepted the following tenders :—

80 arc lamp columns for the Nine Elms and other extensions, Falkirk Iron Co., Ltd., £910 6s.

Annual supply of electric incandescent lamps required in the various buildings of the Council, British Thomson-Houston Co., Ltd., 8 and 16-C.P. lamps, 7¾d. each; Edison & Swan United Electric Light Co., Ltd., 8⅝d. each.

L.C.C.—The L.C.C. has accepted the tender of the Frodingham Iron & Steel Co., amounting to £2,750, for the supply of side-slot rails for the northern tramways in Kingsland Road. The list of tenders was given a week ago. The following tenders were received for the fish plates required for the rails :—

Continuous Rail Joint Co.	(recommended)	£523
P. & W. Maclellan		628
Frodingham Iron & Steel Co.	(not to specification)	715
Steel, Peech & Tozer	(incomplete tender)	132

The above firms tendered out of nine who were asked to submit offers for the plates. It is proposed to entrust Messrs. Reid Bros. with the work, as an extension of an existing contract, of laying cable ducts in connection with the northern tramways, for a sum not exceeding £33,000.

The Highways Committee has reminded the Council of the acceptance last November of the tenders of the Western Electric Co., and W. T. Glover & Co., respectively, for the supply of (1) high-tension cables, and (2) low-tension cables, feeder pillars, &c., for the Westminster to Wandsworth tramways and other lines. At the time it was mentioned that, in consequence of the uncertain state of the copper market, the tenderers had been asked to submit rates of change of price a mile of cable, to be added to, or deducted from, their tenders, according to the actual price of copper as orders were given. The tenders above referred to were accepted on this basis, and the contract prices at that time amounted to £20,549 16s., and £37,860, respectively. Since the date of the acceptance of the tenders, the market price of copper has risen considerably, and does not show any immediate signs of falling. On the other hand, it becomes a matter of urgency to procure the cables required for the electric working of the tramways above referred to. In these circumstances the Committee thinks that the remainder of the cables, &c., to be supplied by W. T. Glover & Co. should be ordered without further delay. This course will involve additional expenditure of about £4,500, but of this sum £3,000 can be met out of the provision of that sum included in the contract price for contingencies.

MARYLEBONE.—The B.C. received 27 tenders for the annual supply of engine room stores for the electricity department, and accepted the following :—

Hobdell, Way & Co.	Geipel & Lange.
W. H. Willcox, Ltd.	British Insulated & Helsby Cables Co.
Henley's Telegraph Works, Ltd.	Baxter & Caunter.

The B.C. has accepted the tender of Messrs. Cloke Bros. to purchase the clinkers and ash at the generating station, estimated at 4,000 yards, for 12 months, at 6d. per yard.

Madrid.—Messrs. Hudson & Bowring, Ltd., have received an order for thirty sets of lifeguards for the tramways of Madrid. This is a repeat order, a contract for 240 sets being awarded to the firm after exhaustive trials, presided over by the Mayor of Madrid, against 40 competitors.

Mussoorie.—The following is a list of the tenders submitted for the Mussoorie hydro-electric and waterworks scheme :—

	Price without power pipes.	Price with power pipes.
Johnson & Phillips, Ltd.	£13,060	£20,960
Brush Electrical Engineering Co. ..	13,538	21,033
Gavin Jones & Son	13,612	20,737
Burn & Co.	13,994	17,982
Bruce Peebles & Co.	(accepted) 14,385	22,395
Lahmeyer Electrical Co.	14,482	—
Bombay Electric Co.	14,808	26,348
Kilburn & Co.	15,162	20,341
Jessop & Co.	15,457	22,442
Siemens Bros. & Co.	16,122	19,335
Crompton & Co.	16,166	20,079
Octavius Steel & Co.	16,199	25,508
Schroder, Smidt & Co.	16,206	23,190
R. Hotz	16,443	22,743
Keymer & Co.	17,168	27,916
Scott Anderson..	18,906	26,906
Greaves, Cotton & Co.	18,846	23,146

Mr. C. H. Shanan, the municipal electrical engineer, informs us that the above figures are open to correction, as there were so many alternatives offered by the different firms tendering, that such a list is very hard to draw up. They may be assumed to be as accurate as possible under the circumstances. As the price of the pipes differed so very much, it has been decided to separate them from the main body of the contract for the present.

Newmarket.—The D.P. Battery Co. have secured the order for 230 L.L. 19-plate cells for the Newmarket central station.

Shanghai.—Messrs. Bruce Peebles & Co., Ltd., have received from Messrs. C. A. Parsons an order for an 800-KW., 2,000-volt, 50-period, single-phase, turbo type alternator for the Shanghai Municipality. This machine runs at 1,500 revs., and the order includes a direct-coupled exciter.

Sunderland.—Messrs. Bruce Peebles & Co., Ltd., have secured the order from the Corporation for a 250-KW. motor-generator for the Pallion sub-station. This machine is to run at 500 revs. and 50 periods, the alternating current voltage being 5,000, and the continuous current 250.

West Ham.—The Corporation on Tuesday considered tenders for a motor-generator and accepted the lowest, that of the General Electric Co., Ltd., for £1,190.

Hard-Drawn Copper Wire.—In the *Harvard Engineering Journal* for November last, an account is given by Mr. T. B. Doolittle of the introduction by him of hard-drawn copper wire into the electrical industry. His experiments and the first installation were carried out at the works of the Ansonia Brass and Copper Co., in 1877, but it was not until 1884 that the material came into extended use. Needless to say, thousands of miles have been erected since that date. While soft commercial copper has a tensile strength of 28,000 lb. per sq. in. with an elongation of 36 per cent., hard-drawn copper has a tensile strength of 64,600 lb. per sq. in., and an elongation of about 1 per cent., being considerably stronger than iron wire and having only one-seventh of the resistance of the latter for the same dimensions, with an impedance estimated (for telephonic purposes) as only one-ninth as great.

FORTHCOMING EVENTS.

To-day's Events (Friday, March 30th).—At 9 p.m. Royal Institution. Prof. P. Zeeman (Amsterdam) on "Recent Progress in Magneto-Optics."

Electrical Standardising, Testing and Training Institution. Mr. J. B. C. Kershaw on "Fuel Economy in Electric Lighting."

At 8 p.m. Electro-Harmonic Society. Last Smoking Concert of the season.

Saturday, March 31st.—At 3 p.m. Royal Institution. Prof. J. J. Thomson on "The Corpuscular Theory of Matter." (Lecture V.)

At 7.30 p.m. Glasgow Technical College Scientific Society. Annual General Meeting.

Monday, April 2nd.—At 7.30 p.m. Society of Engineers. Meeting at the Royal United Service Institution.

At 8 p.m. Society of Arts. Cantor Lecture by Prof. V. B. Lewes on "Fire, Fire Risks and Fire Extinction." (Lecture IV.)

Wednesday, April 4th.—At 7.30 p.m. I.E.E. (Birmingham).

Thursday, April 5th.—At 5 p.m. Royal Institution. Prof. B. Hopkinson on "Internal Combustion Engines." (Lecture III.)

At 8 p.m. I.E.E. "Electrical Equipment of the Aberdare Collieries of the Powell Duffryn Co.," by Mr. C. P. Sparks. "Electric Winding Considered Practically and Commercially," by Mr. W. C. Mountain (abstract of paper read at Manchester). Conclusion of Discussion.

At 8 p.m. Civil and Mechanical Engineers' Society. Mr. G. D'A. Meynell on "Steam Turbines."

At 8.30 p.m. Chemical Society. Meeting.

Friday, April 6th.—At 7 p.m. I.E.E. (Manchester). General Meeting. Mr. D. L. Sands on "The Selenium Photometer."

Saturday, April 7th.—At 3 p.m. Royal Institution. Prof. J. J. Thomson on "The Corpuscular Theory of Matter."

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

The following orders are issued:—

Monday, April 2nd.—"A" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m; N.C.O. class, 9 p.m.

Tuesday, April 3rd.—"B" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.; medical examination recruits, 7 p.m.

Wednesday, April 4th.—"A" badge examination for "A" and "B" Companies.

Thursday, April 5th.—"C" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.

Friday, April 6th.—"D" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.

Saturday, April 7th.—Week-end instruction for "D" Company.

J. H. S. Phillips, Captain E.E.

For O.C.E.E.R.E. (V.).

NOTES.

The Wolfram Lamp.—It is reported from Vienna, that the German patents for the Wolfram lamp have been sold to financiers at Augsburg for the sum of £40,000, of which one-half is payable in cash, and the other half in shares of a new company which is to be formed with a paid-up share capital of £42,500 for the development of the invention in Germany. The manufacture of the lamp has been entrusted to the Augsburg-Lechhausen Glühlampen Fabrik, of Georg Ludecke & Co. It is stated that the acquisition of the English patents by the Austrian inventors, or patent holders, of the lamp has been postponed. The lamp is the invention of Herr Koszel, and a 15 per cent. share in it has been secured by the Vereinigte Elektrizitäts Gesellschaft, of Buda-Pesth, together with the licenses for Austria-Hungary, Italy, Russia, Belgium, Spain and Portugal. This company has a share capital of £41,000, and is now, with the guarantee of two banks, increasing it to £166,000, and changing the title to the Ver. Glühlampen und Elektrizitäts Gesellschaft. In the International Glow Lamp Syndicate, the company has an allotment of 3,100,000 lamps per annum, and receives on national grounds special consideration at the hands of the Hungarian Postal Administration. The augmentation in the share capital, and the alteration in title, would appear to indicate the company's intention to develop its foreign licences for the Wolfram lamp, which is claimed, according to sensational Vienna Bourse reports, to have a life of 6,000 hours, and to be exceedingly economical in the consumption of energy.

Glasgow Electrical Contractors' Dinner.—The annual dinner of the Scottish Section of the Electrical Contractors' Association was held in the Grosvenor Restaurant, Glasgow, on Wednesday last week. Mr. Thomas Wright (president) occupied the chair, and the company numbered over 70. The toast of "The Local Branch of the Association" was proposed by Mr. W. W. Lackie, chief engineer to the Glasgow Corporation Electricity Department. In the course of his remarks, he said that the electrical contractor was the best friend of the supply undertaking, and he only wished that the contractors and the electricity departments' officials had more frequent opportunities of meeting together in a social capacity. If their Association had done nothing beyond bringing the interests of the profession before the Board of Trade and Parliament, in the opposition which they had organised to certain Parliamentary Bills, they would have done very good work. Mr. Wright (the chairman), in responding, thanked the proposer of the toast for his complimentary remarks. He could almost feel for his friend Mr. E. L. Berry, of the parent Association, whom they had present that night. Mr. Berry no doubt would like, if he could, to say the London contractors were on the same terms of friendship with the London County Council as they enjoyed in Glasgow with the Corporation Electricity Department's officials. Proceeding, Mr. Wright referred to the work of the local association, and said that during the year they had on two occasions met with the contractors who were still outside the Association, and they had succeeded in getting some of them to join. The difficulties connected with their business would never be overcome until they had the whole of the members of the profession connected with the Association. It was sometimes said by contractors that they were getting on well enough without joining the Association, but those people had to remember that they would not get on so smoothly but for the operations of the Association. Individuals could do a lot, but they could not face the great Corporations nor the federated manufacturers. The Cable-Makers' Association would never have granted them the concessions which they had done, had they not known that the contractors had a strong Association behind them. As it was, they were looking forward to reaping the benefit of one part of the agreement which they had come to with the Cable-Makers' Association, in the shape of 7½ per cent. on all cable bought for the year. Another important part of the work which the parent Association had done was in resisting the London County Council. That Council attempted to carry a Bill through Parliament, which would have given them the power to carry out the whole of the wiring in London. The Association appeared before the Committee in the House of Lords and succeeded in getting that part of the Bill thrown out. They thought they had killed it, but it had come to life again and would have to be fought once more. If that Bill were carried it would form a precedent for every Electrical Bill that had to pass the House of Commons, and every municipality and supply authority by having those clauses put into their Bills would have a power given them which would enable them to do practically the trade of the electrical contractor.

The Olympia Electrical Exhibition Balance-Sheet.—Mr. W. Davenport, the secretary of the Executive Committee Electrical Exhibition, 1905, writes as follows:—"I am instructed to inform you that the final balance-sheet of the Olympia Electrical Exhibition, duly audited, was received and adopted at a meeting of the Executive Committee held on the 19th inst. The financial result shows a profit balance of £3,683 9s. 1d., and after returning to all exhibitors a rebate of 25 per cent. on the amounts paid by them for space, which absorbed a sum of £2,168 1s. 3d., there remains a balance of £1,515 7s. 10d., which has been dealt with as follows:—A donation of £350 has been made to the Benevolent Fund of the Institution of Electrical Engineers, instead of £250 as previously announced. A donation of £650 has been made to the Electrical Trades Benevolent Institution, under the auspices of the National Electrical Manufacturers' Association, Incorporated. The balance of £515 7s. 10d. will be invested in the names of trustees to form a nucleus of a fund for starting another Electrical Exhibition, which must be held in London under the auspices of the Institution of Electrical Engineers. In the event of no such Exhibition being held within five years, this balance to be divided between the two Benevolent Funds above mentioned in the same proportions as now allocated. The trustees are Sir Wm. Preece, Mr. E. Cunliffe Owen, Mr. J. E. Kingsbury, Mr. C. S. Northcote, and a nominee of the Incorporated Municipal Electrical Association."

Institution and Lecture Notes.—Liverpool Engineering Society.—"Electrical Testing" was the subject of a paper read by Dr. E. W. Marchant, A.M.I.E.E., before this society on Wednesday last week at Liverpool University. Mr. J. Reney Smith, President of the Society, presided. Electrical tests, Dr. Marchant said, might be divided into two large groups: (1) Tests on materials; (2) Tests on apparatus, machinery, and complete installations. Speaking of the first, the Professor said that the use of materials of good quality was essential for the successful manufacture of any electrical machine. After noting points in reference to insulation resistance and dielectric strength, tests of the magnetic qualities of iron were dealt with. In determining hysteresis loops for ring samples of iron it had been found convenient, the Professor said, to adopt the double winding first suggested by Evershed and Vignoles, and to carry the iron through the various stages of magnetisation quite continuously. For testing bars of iron, some form of yoke method was used. He desired to say a good word for the old Hopkinson bar and yoke method, in which the bar was split and the coil for measuring the induction through it was withdrawn rapidly by withdrawing one half of the split bar through the yoke. If the Crompton yoke method were used, in which the bar was continuous and the flux threading the iron coil was measured by reversing the current through the exciting coil, a galvanometer of long period must be used if accuracy was to be attained. Proceeding to speak of tests on apparatus and machines, instruments and meters, Dr. Marchant said that, for alternating currents, the best semi-standard he had found was a Kelvin multicellular voltmeter; for higher accuracy a reflecting instrument should be used, while for alternating-currents the Kelvin balance served as a very suitable standard for measuring power. Another very satisfactory instrument was a deflectional reflecting wattmeter. Data of a number of tests on many different meters were given, the results, in the Professor's opinion, showing what a high degree of accuracy had been attained in the manufacture of meters. Speaking of incandescent lamp testing, the effective testing of lamps was, he said, a very difficult matter, since the satisfactory running of a lamp depended

so much on the kind of treatment to which it was subjected. The only scientific test that could be made was one on constant pressure; running under those conditions it was possible to predict fairly closely how any particular type of lamp would behave. A large number of tests had been carried out by Mr. H. F. Howorth in that laboratory on the luminous efficiency of different lamps running under constant pressure, with alternating-current of 50 cycles frequency, and the results, though not yet complete, were most interesting. It was no uncommon thing to find that two lamps rated at the same candle-power, and in some cases even made by the same maker, gave quite different amounts of light. In tests made so far, it had been found that the general character of a lamp's behaviour could be determined fairly accurately after a six-hour run. It would, Dr. Marchant thought, be desirable, where lamps of high efficiency were essential, that tests should be carried out which lasted at least that length of time. The testing of electrical machinery was treated briefly, different sets of apparatus used for the purpose being described. Dr. Marchant also gave a brief description of the laboratories of applied electricity in the building in which the meeting was held.

The President, in moving a vote of thanks to Dr. Marchant, said it was a new departure to them to hold their meeting in the University building, and he thought that in future the system might be adopted more than it had been in the past.

Mr. T. L. Miller, alluding to Dr. Marchant's references to specifications for cables, thought that if they took a cable for house work on the megohm resistance per mile, they would probably get an inferior cable. If they asked for a graded cable, they would get something higher than they asked for, and something which the makers were prepared to guarantee.

Mr. Thomas Duncanson said that most meters were very accurate to start with, but after a time there was a variation.

Mr. Edward Allen (gas engineer) said the records of electric meter testing in Liverpool compared very badly with the testing of gas meters, and in assessing the gas meters the customer had 2 per cent. granted him. With regard to lamps, it was gratifying to the profession that the results were more satisfactory per watt than they used to be in the old days, but he thought there was a great improvement required. He had tested a 2,000-c.p. electric lamp, and found it giving 1,200 candles, and a 1,000-c.p. electric lamp and found it giving 600 candles, so that there was evidently room for improvement. He spoke very kindly of electricity, because they were using it in their own works for power; not, however, for lighting.

Dr. Marchant replied briefly, and then the members proceeded to the laboratory to view some of the testing apparatus of which he had spoken.

The Institution of Electrical Engineers (Students' Section).—The Committee of this Section is organising a visit to Manchester and district from Monday, April 23rd, to Saturday, April 28th. A break will be made in the journey at Rugby to visit the works of the British Thomson-Houston Co. The following is the full list of the works to be visited:—

Monday Afternoon.—British Thomson-Houston Co., Ltd., Rugby.
Tuesday Morning.—Messrs. Crossley Bros., Ltd.
Tuesday Afternoon.—Chloride Electrical Storage Co., Ltd.
Wednesday Morning.—British Westinghouse Co., Ltd.
Wednesday Afternoon.—General Electric Co., Ltd.
Thursday Morning.—Lancashire Dynamo and Motor Co., Ltd.
Thursday Afternoon.—Messrs. John Musgrave & Sons, Ltd., Bolton.
Friday Morning.—United Electric Car Co., Ltd., Preston.
Friday Afternoon.—Messrs. Dick, Kerr & Co., Ltd., Preston.
Saturday Morning.—Manchester Corporation electricity supply stations.

On 21st inst. in the Elswick Institute, Newcastle, Prof. Thornton lectured on "Electric Currents: their Nature and Properties."

American Street and Interurban Railway Association.—This Association, which has recently been enlarged and reorganised, now represents 250 light railways in all parts of the U.S.A. Among the objects of the Association is the standardisation of equipment and the perfecting of a method of book-keeping and statistics suitable for international use. Its method of accounting is said to be already used on the Glasgow tramways.

The Electro-Medical Quackery Case.—The hearing of the charges against "Professor" Richard was continued for the fifth day last week. A large number of additional charges were mentioned, and expert medical evidence was given to show that prisoner's claims to be able to effect certain cures of blindness electrically were absurd. The case was adjourned for a week, defendant being admitted to bail.

Electric Shock Fatality.—An inquest was held at West London last Saturday into the death of Ernest Richard Bone, an assistant electrician, aged 26, who had been in the service of the Central London Railway for 11 months. According to the evidence of Robert Prinn, electrical engineer at the Notting Hill Gate sub-station, Bone and he were discussing the advisability of some bolts being tightened on the high-tension board, where there was a voltage of 5,000, when Bone, in pointing to a bolt above the level of his head, accidentally touched the "live" bolt. Prinn dragged him down, and he said, "I'm all right," but became unconscious. A doctor was sent for and artificial respiration was resorted to for two hours without effect. They had rubber gloves to use, but they would have given no protection at high tension. Had any work been necessary there they would have had to switch the current off. Mr. E. P. Grove, chief engineer on the railway, said there was a voltage of 5,000 on the high-tension board, which was used to convert a voltage of 5,000 alternating to 300 and then to 550 continuous current. Work would not be attempted without cutting the current off. It was by pure inadvertence that the deceased in raising his hand to point touched the live bolt. Medical evidence showed that there was a deep burn on the index finger of the right hand, and also on the knee. Death was due to syncope, from the electric shock. The jury returned a verdict of "Death from an Accidental Cause."

Gas Power.—The Burton-upon-Trent Corporation has felt it necessary to make very material reductions in the price of gas for power purposes to compete with the producer plants. In fixing these prices it has been assumed that a producer plant below 10 h.p. cannot compete very successfully against town gas, so the annual consumption on which the reduction takes place is what one would expect for producer plants of about 10 h.p. capacity. There are only two producer plants in Burton at the present time. Electric power has prevented other cases arising, and the reductions in gas just adopted have also stopped several intending purchasers from installing producer plants. The Electricity and Tramways Committee has instructed Mr. P. J. Pringle, the borough electrical engineer, to report on reductions in the present prices for electric power somewhat on the same basis as the reductions in the price for gas. The alterations just recently passed by the Council with regard to the charges for gas are shown below; the price per 1,000 cb. ft. before the revision was 2s. 4d. for power. For gas supplied within the borough for gas engines only:—

(*a*) When the quantity supplied per annum is under 400,000 cb. ft., at the rate of 2s. 4d. per 1,000 cb. ft.

(*b*) When the quantity supplied per annum on one premises is 400,000 cb. ft. and under 3,000,000 cb. ft., at 1s. 9d. per 1,000.

(*c*) When the quantity supplied per annum on one premises is 3,000,000 cb. ft. and over, at the rate of 1s. 6d. per 1,000 cb. ft.

New Parliamentary Bills.—According to a recent B. of T. return, there are 25 Tramway Bills before Parliament, relating to 92 miles of track, and representing an outlay of £2,913,537. There are also 28 electricity supply schemes, including the London Power Bills, which in the aggregate involve a capital outlay of over 18 millions sterling.

Municipal Contracting at Liverpool.—The questions of trading in the electrical department of the Liverpool Corporation, and of the effect of such trading on electric light contractors in the city, have been raised in a direct and interesting way. On January 30th last Messrs. E. Forrester & Co., electric lighting engineers, addressed a letter to the Electric Lighting Committee, stating that they would like to know if the Committee were aware how they (the correspondents) and other firms engaged in the electric light and fitting business were deprived of work, and in many cases undercut in estimating for work, by the electrical engineering staff in Highfield Street. As a specific case, that of the fitting of an office at No. 14, Castle Street, was cited. The firm stated that they estimated for the electrical fittings and were under-estimated by the Corporation department; they therefore decided to watch the progress of the work. In their opinion, the amount for which the Corporation department had tendered would not represent the cost of the wages of the members of the staff engaged on the work.

A reply, dated Februay 16th, was received by the firm in question from Mr. Alfred Clough, resident electrical engineer. It stated that the contracting business of the Corporation was acquired by it under Parliamentary powers from the Liverpool Electric Supply Co., Ltd., for the benefit of the ratepayers at large.

A second letter, dated February 26th, was sent by Mr. E. Forrester to the Electric Lighting Committee, urging that his firm begged to differ from the remarks in the letter sent to them, that any work done by the Electric Lighting Department was done for the benefit of the ratepayers at large. The opinion of the firm, based on facts, was that it acted to the contrary, and was only for the benefit of the select few.

On March 12th the town clerk wrote officially to Messrs. Forrester, stating that their letter had been submitted to the Committee, and that he was instructed to inform them that the Committee were carrying on the business under statutory powers, as obtained from the Liverpool Electric Supply Co., Ltd. The Committee had not made any change in the character of the business, since it acquired it, and having regard to its position as trustee for the public, it did not consider it would be justified in abandoning any portion of the lighting company's business which could be carried on remuneratively. Thereat, for the time being, the matter stands.

Niagara Falls.—It is stated in a report to the Ontario Legislature that the utilisation of the Falls for power purposes has already reduced the volume of water flowing over by 7 per cent., or from 222,400 to 205,000 cb. ft. per second. Though this has caused no appreciable effect on the Falls, a reduction three times as large is in contemplation. The report states that the agitation to restrict the further abstraction of the Niagara River water is well founded, and suggests that the whole subject be referred to an international commission appointed by the Governments directly interested. The *Times* says that 11 American and six Canadian companies are at present using the Falls for power purposes, and that 10 more charters have been given to companies granting them power to use the Falls.

A Toronto dispatch to the *Daily Chronicle* says that the matter is a Canadian rather than a British problem, and it would be wise for the British Minister at Washington to leave the negotiations connected with it largely in Canadian hands.

The Dominion Government proposes to tax the electricity generated on the Canadian side and exported to the United States,

and it may attempt to assert its sovereignty over the whole of the Canadian side, in which case the Province of Ontario will protest.

A dispatch from Washington to the *Times* says that Mr. Roosevelt, in a Message to Congress, recommends the passing of a Bill to preserve Niagara Falls without waiting for any treaty with Canada to be made.

Information Wanted.—A correspondent wants the address of makers of rotating switches for changing letters to form different words in electric flash signs.

Another correspondent inquires the address of a company formed to construct electric tramways outside Cairo.

Water-Power for Sale.—In the *Times* of 24th inst. is advertised a Canadian developed water-power of 28,000 H.P., with a fall of 19 ft., on the Winnipeg River, to be sold by auction at Ottawa on July 5th.

Appointment Vacant.—Station superintendent for Pigeon House generating station, Dublin (£200+).

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.

Central Station Engineers.—Mr. J. A. Crowther, mains superintendent at the Coventry electricity works, having resigned, the Electric Light Committee have appointed Mr. W. J. Marston, the senior charge engineer, to be outside superintendent.

Last Saturday at the Nelson Corporation electricity works Mr. Fenton, who for a few years has been employed at the works as an engineer, and who is shortly leaving for Canada, was presented with a handbag, shaving outfit, and a pipe and pouch. Mr. Henry, tramway manager, made the presentation on behalf of the employés.

Mr. H. J. Nisbett, managing engineer at the Sheerness electric power station, a presentation to whom was mentioned in our issue last week, has been promoted to the head office of the B.E.T. Co.

The Hammersmith B.C. has been recommended to grant the following increases of salary to officials in the electrical department:—Mr. F. Hill, from £325 to £350; Mr. R. H. Paterson, from £250 to £300.

The Shipley U.D.C. has increased the salary of Mr. S. D. Schofield, electrical engineer, from £250 to £275 per annum.

Tramway Officials.—The Manchester T.C. on March 21st rejected, by 42 votes to 25, a recommendation from the Tramways Committee to increase the salary of Mr. Oakes, traffic superintendent, from £400 to £425, and also a recommendation to increase the salary of Mr. Hughes, secretary to the Electricity Committee, from £400 to £425. The salary of Mr. Jas. Wood, financial superintendent to the Tramways Committee, was increased from £375 to £400 per annum.

The employés of the Sunderland Corporation tramways have presented a silver tea set to Councillor T. Summerbell, M.P., the late chairman of the Tramways Committee.

At a smoking concert on Tuesday, Mr. Howell J. David, traffic superintendent of the Cardiff Corporation Tramways, was presented with a gold watch and chain by the employés of the department, to celebrate the completion of his fifteenth year of service. Mr. Arthur Ellis presided and made the presentation.

General.—On Saturday evening, February 24th, a representative gathering of Durban electrical engineers assembled at the Royal Hotel to bid farewell to Mr. H. P. Bailey, the South African manager of the India-Rubber, Gutta-Percha, and Telegraph Works Co., Ltd., of Silvertown, London. The chief Government electrical engineer (Mr. F. W. Mills) was in the chair, and was supported by the borough electrical engineer, Mr. John Roberts. Amongst others present were Mr. T. P. Pask, assistant Government electrical engineer; Mr. A. Taylor, assistant borough electrical engineer; Mr. D. C. MacIlleron, Government telegraph engineer; Mr. H. N. Thomas, municipal tramways manager; and Mr. F. Margrie, manager for Messrs. Hubert Davies & Spain, of Durban. In presenting a silver cup to Mr. Bailey, the chairman feelingly expressed the regret of the company and of the electrical fraternity throughout South Africa at the departure of the Silvertown Co.'s popular manager, and hoped that it would not be long before he again returned to Natal. During the course of the evening a proposal for forming an Association of Electrical Engineers in Natal was discussed, and it was unanimously decided to celebrate its inception at an early date with a dinner.

It is announced that Mr. H. Llewellyn Smith, C.B., has been appointed to discharge the duties of permanent secretary to the Board of Trade during the absence of Sir Francis J. S. Hopwood, in South Africa.

Mr. John F. Wallace, formerly chief engineer-in-charge of the U.S. Isthmian Canal construction, has received an appointment with the Westinghouse Co. at a salary of £10,000. Mr. Wallace was formerly closely associated with Mr. George Westinghouse in his various electric traction enterprises.

Mr. T. Roland Wollaston, M.I.M.E., consulting engineer, notifies that he has removed his offices to Lord's Chambers, 26, Corporation Street, Manchester. This is also the new address of the Electrofons Co.

Mr. W. E. Warrilow, A.M.I.E.E., is resigning the editorship of the *Electrical Magazine*, and will shortly start business as electrical publicity expert and consulting engineer at 49, Milford Avenue, Watford.

Mr. R. F. Botting, one of the directors of Messrs. Harris, Lee and Co., Ltd., of Johannesburg, is expected in London at the end of this month. He can be seen at the firm's London address (165, Queen Victoria Street, E.C.) by appointment.

The male staff connected with the Blackburn District of the National Telephone Co., Ltd., held their annual dinner and smoker at the White Bull Hotel, Blackburn, on Saturday, covers being laid for 70. The district manager, Mr. C. Remington, M.I.E.E., presided, and at the outset said he was honoured by presiding over so large a gathering, more especially as all grades of the company's service were represented. He regretted the inability of Mr. Shepherd and Mr. Prout to be present, but he had received messages of good wishes from both gentlemen. They were all gratified to have amongst them Mr. Ashton (Lancaster) and Mr. Arthur (Preston), both of whom had gone to great trouble so as to be once more amongst old colleagues and old friends. He alluded to the good feeling existing between the various departments of the huge concern, of which they were all representatives. The programme of music and songs that had been provided by Mr. Etherington, secretary to the Dinner Committee, was lengthy and varied.

Obituary.—We record with regret the death of Mr. Carl Heinrich von Siemens, M.I.C.E., M.I.E.E., chairman of Siemens Bros. & Co., Ltd., who passed away last week at Mentone. Mr. Siemens was born in 1829 at Menzendorf, in Mecklenburg; he was the sixth son in a family of eleven sons and three daughters. For the greater part of his life he co-operated with his brothers Ernst Werner, William and Friedrich, and with the first-named two he was instrumental in the development of the firms of Siemens Bros., and Siemens & Halske, and of the various undertakings with which the name of Siemens is associated. As an inventor his name is not so well known as those of his brothers, but he was a man of great energy and perseverance, and made a name as a capable administrator and organiser.

After the death of his father in 1839 he lived for a time in Lübeck, and subsequently completed his school days in Berlin. Later he became the assistant, in the firm of Siemens & Halske, of his eldest brother, the late Dr. Werner von Siemens, whom he helped to lay the first underground wires. In 1848 William, Carl and Friedrich followed their elder brother to the war, the last two entering the Schleswig-Holstein army as volunteers, and remaining till the conclusion of the armistice. Carl afterwards entered a chemical factory in Berlin, which he soon quitted to assist Werner in the maintenance of the telegraph lines. In 1851 he, with Friedrich, represented the Berlin firm at the London Universal Exhibition, and at a later date was appointed manager of the Paris branch of the Berlin firm; in 1852 he came to London to take charge of the London office of his brother William, who was then engaged at Birmingham on researches in connection with the regenerative steam engine. In the same year the Berlin firm was entrusted by the Russian Government with important telegraph contracts, which resulted in Carl being appointed to take complete charge of the firm's interests in Russia, and it was mainly owing to his energy and ability that the Russian business grew so rapidly and to such considerable proportions. In 1855 he took charge of a large branch factory at St. Petersburg. In the year 1864 Mr. Halske severed his connection with the London firm, which was then reconstituted with the three brothers, Dr. Werner Siemens (of Berlin), Mr. Charles William Siemens (of London), and Mr. Carl Heinrich Siemens (of St. Petersburg), as partners. This business was carried on from the beginning of 1865 as "Siemens Brothers." In 1869 Mr. William Siemens found that his private work was engrossing his time and attention, and requested his brother at St. Petersburg to share in the management of the London business. Carl had already erected all the most important telegraph lines in Russia under enormous difficulties, and, owing to the expiration of the Russian maintenance contracts, he was free to comply with his brother's wishes. He worked in conjunction with his brother William for eleven years, during which period the Woolwich Works were gradually enlarged, and a gutta-percha factory established there. Amongst other interests, he took an active part in the laying of submarine cables; in 1874 he took charge of the expedition of the firm's new cable ship *Faraday* on her maiden voyage, for the purpose of laying the Direct United States cable, the first trans-Atlantic cable made by the firm of Siemens Bros. In this connection it is interesting to record that he was the first who succeeded in raising from the bed of the Atlantic a broken submarine cable. In 1880 the firm of Siemens Bros. was converted into a limited liability company under its present title, Carl remaining one of the directors, but about this time his health began to decline, owing to the dampness of the English climate, and he returned to St. Petersburg, where he again settled down and took over once more the management of the Russian business, which, under his control, gradually developed the electric lighting and power industry in Russia, and increased rapidly in size, employing now some 1,000 hands. When Dr. Werner von Siemens died in 1892, Mr. Carl Heinrich von Siemens was called to Berlin to take the leadership of the firm of Siemens and Halske, and in that year also he was elected to the chairmanship of Siemens Bros. & Co., Ltd., which position, as stated, he held till his death. During his career he received the Orders of many countries, and in 1895 the Russian hereditary rank of nobility was conferred on him.

Mr. Carl Heinrich von Siemens's character may best be summed

up by quoting from the "Personal Recollections of Werner von Siemens":—"I should call the next brother Charles the most normally constituted of us all. He was always to be depended upon, faithful and conscientious, a good pupil, an affectionate, attached brother. His clear eye and generally cultivated understanding made him an excellent man of business, and with his large technical knowledge and an excellent tact, an admirable conductor of business undertakings. Charles was the true connecting link between us four brothers, who differed indeed radically from one another, but were bound together for life-long common work by all-subduing fraternal love."

NEW COMPANIES REGISTERED.

Ludlow Electric Light Co., Ltd. (88,018).—This company was registered on March 17th, with a capital of £8,000 in £1 shares (4,000 4 per cent. cumulative preference), to acquire the rights and powers of W. Norton under the Ludlow Electric Lighting Order, 1905, to adopt agreements (1) with W. Norton, and (2) between W. H. Marston and C. B. Marston of the one part, and W. Norton of the other part, for a lease of a site for generating works, and to carry on in Ludlow and neighbourhood the business of an electric light and power company in all its branches. The first subscribers are:—J. C. Mackay, Llanwye, Hereford, civil engineer, 200 ordinary shares; J. Mitchell, Bryntirion, Hereford, tailor and draper, 100 ordinary shares; W. Norton, Corve Street, Ludlow, auctioneer, 50 ordinary shares; J. Parker, 14, Nelson Street, Hereford, civil engineer, 200 shares; E. Turford, Ludlow, builder, 200 ordinary shares; G. Woolley, Bull Ring, Ludlow, printer and stationer, 100 ordinary shares; and J. Webb, 11, Poultry, E.C., sanitary engineer, 100 ordinary shares. Minimum cash subscription, £1,000; the number of directors is not to be less than three nor more than five; the first directors are J. Mitchell, J.P., E. Turford and G. Woolley; qualification, £100; remuneration as fixed by the company. Registered office, 14, Corve Street, Ludlow, Salop.

Car and Wheel Construction Co., Ltd. (88,060).—This company was registered on March 21st, with a capital of £6,000 in £1 shares, with objects as indicated by the title. The first subscribers (each with one share) are:—A. Lang, 22, Tremlett Grove, Highgate, N., accountant; F. Whittemore, 74, Perrymead Street, Fulham, S.W., clerk; H. Archibald, Suffolk House, Cannon Street, E.C., secretary; W. J. Aspinell, 30, Winsham Grove, West Side, Clapham Common, S.W., clerk; R. H. Whittle, 12, Alma Road, St. Paul's Road, Canonbury, N., clerk; S. Cook, 91, Upper Street, Islington, N., clerk; and A. Heiron, 67, Twyford Avenue, Acton, W., solicitor. No initial public issue. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; qualification (except first directors), 150 shares; remuneration, £100 each per annum (chairman £50 extra), to be paid out of the profits available for distribution.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Lancashire United Tramways, Ltd. (87,044).—A debenture dated March 14th, 1906, to secure £20,346 10s. 4d., has been registered. Property charged: The company's undertaking and property, present and future, including uncalled capital. Holders: Parr's Bank, Ltd., 4, Bartholomew Lane, E.C.

Scottish House-to-House Electricity Co., Ltd. (29,232).—A charge dated February 28th, 1906, to secure £250, has been registered. Property charged: The company's undertaking and property, present and future, including the Coatbridge and Airdrie undertakings, benefit of orders and of agreements for lighting and otherwise, and uncalled capital and book debts. Holders: County of London Electric Supply Co., Ltd., Moorgate Court, E.C.

Electric Mercantile Agency, Ltd. (75,039).—This company's annual return, made up to December 31st, 1905, was filed on February 6th, when seven shares had been taken up out of a nominal capital of £1,200 in £1 shares. £1 per share has been called up, and £7 remains in arrears. No mortgages or charges.

Halpin's Patent Thermal Storage, Ltd. (73,347).—This company's annual return was filed on January 20th, when 10,705 shares had been taken up out of a nominal capital of £12,000 in £1 shares. 10s. per share has been called up on 4,405, and £1 per share on 360 shares, resulting in the receipt of £2,502 10s. 6,000 shares are considered as fully paid. Mortgages and charges: Nil.

Burmah Electric Tramways and Lighting Co., Ltd. (75,090).—This company's annual return was filed on January 17th, when 18,395 ordinary, and 20,000 preference shares had been taken up out of a nominal capital of £200,000 in 20,000 ordinary, and 20,000 preference shares of £5 each. £5 per share has been called up on 20,000 preference, and £100,000 has been received. £91,975 is considered as paid on 18,395 ordinary. Mortgages and charges: Nil.

Anglo-Mexican Electric Co., Ltd. (87,403).—A trust deed dated March 2nd, 1906, to secure £300,000 debentures, created February 23rd) 1906, has been registered. Property charged: The company's concessions, lands and immovable property in Mexico and its general assets, present and future, including uncalled capital. Trustees: Sir Weetman D. Pearson, Bt., 16, Carlton House Terrace, London; and C. G. Hyde, 75, Gloucester Terrace, Hyde Park, W.

Empire Electric Light and Power Co., Ld. (London). (75,545).—A debenture dated March 1st, 1906, to secure £6,200, charged on the company's lands, buildings, machinery, works, plant, effects, orders, acts, undertaking and other assets, including uncalled capital, has been registered. Holder: H. L. M. Tritton, 54, Lombard Street, E.C.

Lowne Electric Clock and Appliances Co., Ltd. (80,531).—This company's annual return was filed on February 28th, when 6,507 shares had been taken up out of a nominal capital of £8,000 in £1 shares. £1 per share has been called up on 1,007 and £950 has been received, leaving £57 in arrears; 5,500 shares are considered as fully paid. Mortgages and charges, Nil.

Phœnix Dynamo Manufacturing Co., Ltd. (Bradford) (77,660).—Issue on February 8th of £2,500 4½ per cent. debentures, part of series created same date, to secure £5,000, ranking *parri passu* with £15,000 debentures secured by a trust deed of July 29th, 1903, charged on certain freehold land and premises in Calverley, Bradford, certain British and foreign patents and the company's undertaking and property, present and future, including uncalled capital. A trust deed of even date, covering the £5,000 additional debentures above mentioned, and being supplemental to the said trust deed of July 29th, 1903, has also been registered. Trustees: J. Charlesworth, Wilmer Road, Heaton, Bradford; and F. Sellers, Meols Drove, Wentworth, Hoylake, Cheshire.

CITY NOTES.

British Electrical Superannuation Fund.

The fifth annual general meeting of the contributing members of the above fund was held at Essex Hall, Essex Street, Strand, on 16th inst. There was a large attendance of members. Viscount Emlyn, one of the managing trustees, presided and reviewed the events of the past year. He pointed out that the membership of the fund at the close of 1905 was 203, and stated that no endeavours had been made to obtain the support of new companies pending the receipt of the actuaries' report on their recent valuation, and pending the adoption by the members of the recommendations about to be made with regard to a revision of the rules. The income of the fund for the past year amounted to £4,626, as compared with £4,178 for the previous year. The total assets at the end of 1905 were £15,098, an increase of £4,031 for the year. The investments amounted to £14,468 distributed over 48 different securities, and they yielded an average return of 3·83 per cent. To fill the vacancies resulting from the automatic retirement of three companies' managing trustees, Messrs. G. C. Cuningham, H. C. Levis and P. D. Tuckett, had been elected to represent the companies. The chairman moved the adoption of the report of the managing trustees and statement of accounts for the year 1905. This resolution was carried, and a vote of thanks was given to Lord Emlyn for presiding.

A special general meeting was then held to receive the reports of the actuaries on the valuation of the fund, and to consider the recommendations of the managing trustees and actuaries as to revision of rules. The Chairman (Mr. W. G. Bond), one of the contributors' managing trustees, dealt with the report of the actuaries, Messrs. T. G. Ackland and James Bacon, and in doing so pointed out that the fund had had the benefit of first-class actuarial advice, and that the recent valuation had enabled members to take stock, and, if they so wished, to put their house in order in good time. On the other hand, he did not think members should attach more weight to this report than the actuaries did themselves. The fund had been in existence a very short time; it was small, and the members would see, if they carefully read what the actuaries said, that they dealt only in probabilities and tendencies, and not in what might be called "cock certainties." The actuaries had very few data to go upon, and the experience of the first few years of the fund's existence was altogether abnormal. He then proceeded to deal with the proposed alterations in the rules, and divided them into three classes:—

Class I., which comprised alterations tending to improve the working and administration of the fund.
Class II., which comprised alterations which had been drafted with a view to improve the position of individual members, and
Class III., which consisted of alterations intended to strengthen the financial position of the fund.

He did not propose to say anything about alterations in Class I. With regard to the alterations in Class II., he pointed out that *inter alia* they made the amount to be contributed by the older members less onerous and more flexible. Other rules included in this category gave the managing trustees greater discretion in dealing with the monies left in the fund by members guilty of misconduct. The rule dealing with members obliged to retire before 60 owing to ill-health had also been improved. Coming now to rules tending to strengthen the financial position of the fund, he pointed out that the lump sum contribution of £25 per member payable to the fund by the companies under certain circumstances, would be abolished in future. It had been found to be somewhat of a bar to new companies joining, and as the actuaries reported, it was doubtful whether it was altogether a sound procedure. He also pointed out that in future under ordinary circumstances no member over 30 would be allowed to count back years of service, and in any case not more than five years of previous service would be allowed to count for pension. This precaution had also been strongly recommended by the actuaries. He now came to the new rule which proposed to alter the basis of calculation of the pensions. As the members were aware, under the existing rules the pension was based upon the salary received during the last seven years of membership. In future the pension would be based upon the average salary received during the whole period of service. This step was taken in consequence of the strong advice of the actuaries, whose remarks in their report were quoted at length. In conclusion, the Chairman pointed out that the members belonged to a class of society which had in the past been squeezed, was being squeezed, and in the future would be squeezed still more. There would be no State Old Age Pension for them. He, therefore, urged them to seek rather to mend than to end the fund, and to adopt the suggestions of the actuaries. It was true, of course, that not every member would live till 60, nor be in the service of his present or some other contributing company at that age; yet a large number would be in that position, and he asked them to consider how unpleasant their situation would be if no pension fund existed. It was advisable to do what was necessary to strengthen the fund now rather than five years hence, when the fund might be much bigger, and the presence of a large number of outside companies might render alterations more difficult even than they were now.

As regards members who left the fund before pension age, they withdrew all their own contributions, which amounted in some cases to a very nice nest egg which proved very useful to them when they were out of a job. In some cases they received back their money with simple interest.

Mr. R. J. Howley, a contributing member, thanked the chairman for his very lucid speech, and pointed out the severe reduction in pension which the new rule might effect under certain circumstances. He was, however, in favour of the new rule. He also

hoped that at the next quinquennial valuation the fund would have outside actuarial advice.

Other suggestions were that members should be given an annual statement showing the amount due to them from the fund, that a member's widow should be given his contributions plus 4 per cent. interest.

Mr. C. G. Tegetmeier (companies' managing trustee) said that, to his mind, the proposed alteration in the basis of pension would result in a more equitable division amongst the members of the benefits of the fund. The members must remember that they could not get more out of the fund than the fund had to give. He referred to another superannuation fund with which he had had to do, and quoted remarks from the actuary of that fund, showing how necessary were frequent valuations and revisions of pension scales.

Mr. Emile Garcke (contributing member) said he had come to the meeting with an inclination to be critical. He had heard so many criticisms on the proposed alterations of the rules that he had thought it his duty to read the actuaries' report very carefully, and he must say that when he had read it he felt some of the criticisms were fell founded. He had, however, had the pleasure of listening to Mr. Bond's address, and the way in which he had read extracts from the actuaries' report put an entirely new light on that document, and he thought he could go away and satisfy those who were not present that the proposed alterations were fully justified. He thought the proposed alterations not only advisable in the interests of the stability of the fund, but desirable on the ground of fairness to the general body of members. He realised the huge amount of work that had been done by those responsible for the management of the fund, and begged to thank them for it.

The Chairman then replied to the remarks of the various members, and pointed out that several of their suggestions would no doubt be immediately adopted by the managing trustees, but that the adoption of others must be deferred until after the next valuation.

The resolutions were carried with only one dissentient.

A confirmatory meeting will be called, and after that meeting the new rules will come into force.

Slough and Datchet Electric Supply Co.

The third annual report says that the capacity of the generating station has not been increased during the year, and remains at 870 h.p., but the new boiler of 500 h.p. has been installed, which will enable the whole capacity of the works to be in use at one time if required. The capital expended during the year was £1,596, making £40,578.

A further issue of 15,000 shares was made during the year, and 13,499 of these were allotted and 10s. per share has been called up thereon, bringing the total capital received up to the end of the year to £41,749. The number of 8-c.p. lamps and motors added during the year was 2,997, making 8,605, of which 909 represent motor power. The total revenue for the year was £3,231, against £3,011 the previous year, notwithstanding the fact that the supply in bulk to the Windsor Co. decreased from £1,452 to £1,196. The total net profit available for distribution after adding the balance brought forward from the previous year is £2,005, and out of this the directors recommend a dividend of 3 per cent. per annum less income-tax, £250 being transferred to a depreciation fund, and the balance carried forward. The directors decided to apply for a provisional order for powers of supply in Burnham, Farnham Royal, Horton, Langley Marish, and Stoke Poges, and the application is at present under the consideration of the Board of Trade.

Potteries Electric Traction Co.

The directors' report for 1905 says that the gross receipts amounted to £104,479. After deducting all expenses chargeable to revenue, including repairs and maintenance and debenture interest, there remains a profit of £7,302 plus £472 brought forward. It is proposed to transfer to depreciation and reserve fund, £5,000; to provide for the dividend on the 5 per cent. cumulative preference shares, £12,250; to pay 4 per cent. dividend on the ordinary shares, £9,800; and to carry forward £724. £9,263 has been expended on capital account during the year for construction and equipment of three short extensions (one mile in all), the purchase of two motor-omnibuses, and in general additions to the company's plant.

The Adderley Green, Sneyd Green and Hanford Bridge Extensions were only opened for traffic during November last, and, therefore, the traffic receipts for the year were not materially affected by the results.

The net profit in the parcels delivery department continues to show an increase. Owing to the attitude of certain local authorities the directors have decided to abandon for the present their scheme for the transportation of minerals and heavy goods.

Owing to pressure of other business, Mr. Emile Garcke has resigned his seat on the board. Mr. F. W. Chanter has been elected a director.

	Year ended Dec. 31st, 1904.	Year ended Dec. 31st, 1905.
Route miles open	30·68	31·68
Passengers carried	16,403,351	17,424,667
Average traffic receipts per passenger	1·30d.	1·24d.
Average expenditure per passenger	0·75d.	0·74d.
Proportion of expenses to receipts..	58 per cent.	60 per cent.
Number of cars in stock	105	105

National Electric Construction Co.

The accounts to December 31st show a gross profit of £32,356, and an available balance of £23,585. It is proposed to place £6,500 to reserve, to set aside £1,000 to cover doubtful debts, and £6,184 for depreciation, and to declare a dividend at the rate of 7 per cent. per annum, carrying forward £1,271. For the preceding year 6 per cent. was paid. A dividend of 6 per cent. having been earned on the subscribed shares for two consecutive years, the vendors' shares now rank *pari passu* with the ordinary shares, so that there is now only one class of shares. The company's holding in the Musselburgh Construction Syndicate is now represented by debentures, preference shares and ordinary shares, all fully paid, in the Musselburgh and District Electric Light and Traction Co., and the profit from the first half-year's working of that company was sufficient to pay debenture interest and preference share dividend after placing a substantial amount to reserve. The progress of the electric light undertakings at Bo'ness and Carnarvon has been satisfactory. Contracts for the construction and equipment of tramways between Rotherham and Mexborough, and at Torquay, were secured, and the work is well in hand. The company has taken a financial interest in both undertakings. During the year 19,300 ordinary shares of £1 each were allotted, of which, however, only 4,300 shares rank for dividend out of the year's profits. The directors being satisfied that further capital can be profitably employed, have decided to make an issue of 31,729 ordinary shares of £1 each at par, and to offer them in the first instance to the shareholders in proportion to their holdings.

Marconi's Wireless Telegraph Co.

Sir Charles Euan Smith presided on Monday at River Plate House over the ordinary general meeting of the above company.

In moving the adoption of the report, the Chairman said the net profit for the year under review again showed a substantial increase upon recent years. It was £4,000 in excess of the profit for the year which ended September, 1904, and that was again in excess of the preceding years. This satisfactory result proved that the company was making steady progress, though from the nature of the undertaking it was inevitable that until the organisation had been fully developed this progress must be slow and sure; and it must always be borne in mind that they were not as yet deriving any revenue from that part of the company's undertaking from which the largest profits were anticipated, viz., the use of the Marconi system for carrying on over long-distances, the service that had been commonly performed by telegraphic cables. This being the case, the directors could not but consider that the result hitherto obtained was of a very satisfactory character. Up to the present the shareholders of the company had possibly been more or less accustomed to regard the Marconi enterprise as greatly differing in character from ordinary industrial undertakings, and as possessing the chance of much larger profits than were usually to be anticipated from enterprises of an ordinary industrial character. It afforded, therefore, good ground for satisfaction to reflect that although they had not yet been able to complete the installations from which they anticipated their principal profits, they were still deriving from other branches of their business a revenue sufficient to pay a satisfactory dividend. The retention of the sum that could be made available to pay such a dividend had been determined on by the directors because they wished to strengthen their financial position as much as possible before entering, as they hoped to do, upon the harvest of the large receipts which were anticipated by them on the completion of the necessary installations for trans-Atlantic traffic. The board again wished to draw attention to the form in which their shares in the associated companies were inserted in the balance-sheet. The value put upon them was about £103,000, but this sum must be regarded as a highly conservative estimate in respect of holdings which had a face value of nearly 1½ million sterling. Apart from long-distance communication, it would perhaps be difficult to justify the considerable capitalisation of some of these associated companies; but when it was realised that these companies owned the Marconi rights over such areas as the United States of America and Canada, and that the capitalisation of the cable companies owning the cables laid between these countries and the United Kingdom represented a sum of about £23,000,000 sterling, it would, he hoped, be recognised that when the high-power stations for international communication were in operation, affording a service which they had every reason to believe would compare favourably with that furnished by the cables, the Marconi capitalisations were relatively inconsiderable. The vast capital invested in cable companies, and the large dividends earned by them, were all matters of common knowledge. The directors were confident of the capability of the Marconi system to provide at least a similarly effective service with apparatus which was quite insignificant as to cost compared with the capital cost of the laying down and maintenance of a submarine cable. Was not this an asset which might be regarded as inadequately represented by the par value of the shares of these associated companies? The total capitalisation of the Canadian and American companies was $11,650,000, and of this capital their company owned more than 50 per cent. The operations of these companies, and the stations which they erected and owned, formed part of an organisation of very high prospective earning capacity, of which their company's undertaking represented the complement. Another item in the balance-sheet, in estimating the value of which the directors had acted on very conservative lines, was that connected with their freehold property and manufacturing works. They had during the current year acquired works at Dalston, which, erected only four years ago, figured in the balance-sheet of the then proprietors at about £80,000. These works had been disposed of to the company for a sum of £25,000 in cash, and 5,000 ordinary shares of the Marconi Wireless Co., and they had been pronounced by persons whose judgment was worthy of every consideration, to be the finest works of the kind, and the most suitable, for such manufactures as the company was carrying on, that could possibly be found in the Metropolis. Last year, he referred to the proposal of Germany to regulate for the whole of the world by an international convention, wireless telegraph communication between coast stations and ships at sea. It was a matter of history that a conference of this nature actually took place in Berlin in the year 1903, and was adjourned. A further conference had not yet been called together, although three

years had elapsed, and they might have noted that in a recent discussion in the French Chamber of Deputies the Convention was stated to have been postponed *sine die*. Whether this was really the case or not he was not in a position to state; but he thought they would agree with him that international conventions of this nature were not at the present time held in very high favour, from whatever quarter the proposition for their assembling might proceed. But whether the convention ever actually took place or not was not, in view of the present situation of the Marconi Co., a matter which need seriously disturb, or give anxiety to, the shareholders. It was evident that the real object of the international convention was to affect injuriously the commanding position which their company had successfully established in connection with wireless telegraphy. Other wireless companies undoubtedly gave it their support, but they did not think they were unjust in assuming that this support was not wholly unconnected with the prospect of securing advantages to themselves from the use of the extensive organisation which had solely been established by the Marconi Co. In any case, the fact was made, and was now perfectly clear, that their company was in this matter in a position which was not even approached by foreign companies endeavouring to sell wireless telegraphic apparatus. He might note that the German company, which was known under the somewhat remarkable name of the Telefunken Co., had, from time to time, expressed condemnation of the policy adopted by their company in utilising its apparatus and inventions for carrying on by means of wireless telegraphic apparatus the business of a public telegraph company. It had been said that this policy must be fraught with financial disaster; the indiscriminate sale of apparatus without restrictions as to its use had been advocated. But at the same time the Telefunken Co. strongly supported a scheme for the regulation of wireless working on ships at sea by means of an International Convention which would enable it to enter a field which their company had made its own. The inconsistency between these public declarations and the support of the Berlin proposals was apparent to all. It could not be repeated too often that the main policy of the Marconi Co. was that of utilising its inventions for carrying on a public telegraph service. But in view of the fact that, in almost every quarter of the globe, at the present time, wireless telegraph operations could not be carried on without the permission of the governments of the States in question, many difficult negotiations had to be undertaken and carried through before the company was in a position to give effect to its main policy in foreign countries. These difficulties were enhanced by the fact that the whole question of the successful administration of wireless telegraphy were very imperfectly understood, not only as regards mere technical questions, the comprehension of which by the persons with whom they were negotiating was not very material for their purposes, but also as regarded the many-sided commercial questions which affected the application of the system, and were relevant to the conditions which it was essential they should secure for satisfactory working. Wherever at the present time wireless telegraphic communication with shipping of the mercantile marine was successfully carried on on a commercial scale, the stations engaged were worked in accordance with the procedure which, after long experience, their company had developed. Nevertheless, when the question of the establishment of stations in foreign countries came under consideration, they were always met with the demand that the working of the stations should be under the entire control of the Governments concerned. A consideration of the problems involved must eventually lead to a recognition of the fact that such a plan of operations was not practicable. What might be described as a wireless telegraphic exchange for ship to shore telegraphy was made up of many component parts—coast stations in many countries, and stations on ships of many different lines. All these ships journeying between many different points, and all the coast stations with which they communicated went to make up this organisation, and in order that satisfactory communication might be maintained, it was necessary not merely to have uniform apparatus, but it was absolutely essential to have uniformity of practice and method of working. If alterations were made in one place, they had to be made in another; and whereas for the benefit of the organisation, as a whole, it might be remunerative to the company, which derived its revenues from receipts, to make alterations throughout the whole organisation in order to render the service efficient at any particular point, such alterations could not readily be put in operation, and the necessary expenditure would not be readily faced by a number of different and distinct entities controlling the various coast and ship stations, even if so many diverse interests could ever be brought to agree on a common course of action. The report showed how the company was extending its operations in all parts of the world, and the interest which was being taken in their system on every side. He did not think it was necessary to enlarge upon what had been stated therein. Last year they were compelled to enter into litigation with the De Forest Co. in America, and with Lloyd's Corporation in England. In the first they were the plaintiffs, and won their case. The strength of their position was not now by any means wholly dependent upon the validity of their patents; nevertheless, they would note with gratification what the American Judge had to say upon the matter. As to the litigation with Lloyd's Corporation, they were the defendants in the action, but the matter was settled out of Court at the request of the plaintiffs on terms which were wholly satisfactory to their company. He would also call their attention to the extremely satisfactory progress that had been made in connection with their installation of ocean-going ships. The number of these was steadily increasing, with a proportionate and steady increase in revenue. The general demand of the travelling public was for more installations of far greater power for transmitting and receiving messages than was possessed by those at present in use on most of the fitted ships. All this would come in due course. They could see no limit to the business which awaited them in this direction. From every quarter they received assurances of the success of their service. In conclusion, the chairman asked the shareholders to pass a vote of thanks not only to Mr. Marconi, whose estimable services increased in value with the passing years, but also to their managing director, Mr. Cuthbert Hall, whose ability, zeal and energy in the interests of the company the board appreciated more fully year by year. No one could have fought the up-hill battle that the company had had to wage against innumerable difficulties with greater success, perseverance, loyalty and ability than the managing director. In the vote of thanks he included without exception all the subordinate officers of the company, who worked with a will under their efficient leaders.

The report was adopted.

Brush Electrical Engineering Co.

The report for 1905 to be presented at the annual meeting on Tuesday next shows a gross profit of £85,051; general charges, maintenance, interest on debenture stock, and £6,893, carried to depreciation reserve fund, absorb £50,331, leaving a balance of net profit of £34,720. The 6 per cent. dividend on preference shares requires £18,000; a dividend at the rate of 2½ per cent. per annum on the ordinary shares absorbs £5,287; interest payable on loan of £30,740 from the B.E.T. Co., £769; to general reserve fund, £7,550; to balance carried forward, £3,114. The depreciation reserve fund will then stand at £52,000, and the general reserve fund at £24,000. £6,491 17s. 8d. has been expended on necessary additions to plant and buildings during the year. Further extensions are now in progress which, when completed, will add greatly to the company's manufacturing facilities at a relatively small outlay. The arrangements for the formation of a separate company to acquire the electric supply and tramways undertaking at Bombay referred to in the last report, have been concluded during the year, and the company's interest therein has been disposed of on satisfactory terms. Important contracts for power-house plant and electric tramway rolling stock for this undertaking are now in course of execution by the company.

The works output for the year has been the largest in the history of the company, and the general turnover of the contracting and other departments of the company's business has also been satisfactory. There has been a gratifying increase in the demand for the company's steam turbines and reciprocating engines directly coupled to electric generators for lighting, power and traction purposes. In the important field of rolling stock for main line railways, valuable contracts have been secured. The directors look for a large extension of the company's business in this direction, both as regards passenger coaches and in the construction of self-discharging steel goods wagons of high capacity. In view of the rapid development of the motor-omnibus industry, the company has assisted to form, and retains a large interest in, the British Automobile Development Co., Ltd., an undertaking having for its primary object the production of road motor vehicles for passenger and goods traffic. The works of this undertaking adjoin the company's main works at Loughborough, and an agreement has been entered into by which the company will manufacture the body-work required for the vehicles. It is hoped that by close co-operation on these lines, mutually satisfactory results will be achieved.

Winchester Electric Light and Power Co.

The directors' report for 1905 states that the progress made continues to be satisfactory; the equivalent of 5,676 8-c.p. lamps have been added during the year, making the total connection at the end of the year 47,363 8-c.p. lamps. Including the balance of £480 brought forward, there is a net profit of £6,027.

After payment of debenture and loan interest, £2,148; writing off one-third of the cost of the Electrical Exhibition, £105; and the cost of experimental public lighting, £103; and making special provision for doubtful debts, £100; there is a balance of £3,570 available for dividend. An interim dividend for the half-year, at the rate of 4 per cent. per annum, was paid in September last, and the directors now recommend that a dividend at the rate of 7 per cent. per annum be declared for the half-year, (making 5½ per cent. for the year), which will absorb £2,217; that £1,000 be placed to depreciation account, and that £60 (in addition to £311 received as premium on shares and debentures issued during the year) be placed to reserve fund account, leaving a balance of £294 to be carried to the next account. The works are capable of supplying all demands likely to be made for some time to come. During the year 56 ordinary shares have been issued, at a premium and fully paid up, and debentures to the amount of £9,700 have also been issued at a premium.

Evered & Co., Ltd.

The directors' report for 1905 shows, after providing for debenture interest, amounting to £2,375, and income-tax £578, a net profit of £8,631, making, with £1,444 brought forward from 1904, and £3,500 transferred from the fund for the equalisation of dividends, the sum of £13,576 to be dealt with. The directors propose a dividend of 5 per cent. for the year (free of income-tax), £8,537; to write off plant and buildings, £1,500; and to carry forward to next account, £3,539. Notwithstanding intense competition and high prices of raw material, an increased profit has been earned. Ignoring their increased value, stocks of raw material have been taken at the same prices as last year, and machinery, plant and stocks of finished goods are in all cases in excellent condition and up-to-date in character.

Woking Electric Supply Co.

The report for 1905 shows a total revenue of £11,486; the expenditure connected with the generation and distribution of electricity and management amounted to £6,770, leaving a balance of £4,717, to which has to be added £676 brought forward, making a total of £5,393. Interest on the 4½ per cent. debentures absorbs £1,122; interest on temporary loans, £340; dividend on the 6 per cent. cum. pref. shares to December 31st, 1905 (six months to June 30th, 1905, having been paid on October 1st, 1905), £1,500; a dividend of 5 per cent. on the ordinary shares, £933; and to depreciation fund account, £1,000: leaving a balance of £498 to be carried forward.

The following table will show the rate at which the business has progressed:—

	Consumers.	Lamps connected.	Revenue.
1903	680	25,010	£7,952
1904	783	29,566	£10,341
1905	880	33,735	£11,477

During the year the directors have issued £350 4½ per cent. debentures, and £3,160 ordinary shares, and they are desirous of issuing the balance of the ordinary shares. The expenditure on capital account at December amounted to £85,898. During 1905 3¾ miles of cable have been laid down, a second large new boiler put down, and a second 400-kw. steam alternator. In 1905 the Board of Trade granted an extension provisional order for the increase of the company's area, to include Pyrford, Byfleet, Addlestone, Chertsey, and Bisley. For this further capital expenditure will be necessary for laying down the necessary mains, &c.

Bromley (Kent) Electric Light and Power Co.

The directors' report for 1905 states that the progress made by the company has been satisfactory, the lamp connections having increased from 56,198 to 64,957. The sale of current has increased from £11,366 to £12,485.

During the year the new offices of the company have been completed, and are now occupied. During the year £11,400 debenture stock has been issued, and the premiums paid thereon, amounting to £360, have been carried to reserve. The result of the year's trading shows a profit of £8,782, and after adding £86 brought forward from last year, and allowing for debenture and loan interest and trustees' fees amounting to £2,930, the amount available for dividend is £5,938. An interim dividend at the rate of 4 per cent. per annum was paid for the half-year on October 2nd, 1905, and the directors recommend the payment of a further dividend for the last half-year at the rate of 7 per cent. per annum, making a total dividend of 5½ per cent. for the year, and that £2,040 be placed to reserve, making with the amount received in premiums £2,400, leaving a balance of £48 to be carried forward to the next account.

Newcastle and District Electric Lighting Co.

The annual meeting was held on 20th inst. Sir John D. Milburn, Bart., in moving the adoption of the report (see Electrical Review, March 16th), said that during last year they had increased their sales from 3¾ million units to about 5½ millions. This was on account of their having additional plant to convert the company from a simple lighting concern to a cheap working power company. This increase of plant had meant increase of capital, but they had had before them the necessity of getting customers to meet this. This they had, in a large measure, succeeded in doing, but, at the same time, the dividend had been necessarily reduced. He expressed the hope that they had got through most of their troubles, because they saw a very great reduction in the cost of their power stations, and also the possibility of increasing the output of energy. This economy, taken together with the increased revenue receivable for current, should put the company into a better position than it had been in before. Of course, if they had had their choice, they would have continued to pay large dividends on a comparatively small capital, but the extensions had been forced upon them by the action of other companies, and they had had to go with the times. They were in this position now, that they were able to produce electricity almost, if not quite, as cheaply as anyone else, and they felt themselves more secure than they had for a long time past. He moved the adoption of the report and a dividend at the rate of 5 per cent.

The report was adopted.

The retiring directors were re-elected.

Johnson & Phillips, Ltd.

Mr. R. W. Blackwell presided at the first annual meeting held at Winchester House on Monday, and in moving the adoption of the report (see Electrical Review, March 23rd), he said that the company while registered in June last did not acquire possession of Johnson & Phillips until two or three months later. There were many questions which would naturally arise in the business which had long been conducted by an individual, which naturally had to be carefully brought into line before they could be taken over by a limited company. Among them were a very large number of questions as to the ownership of the real property acquired, all of which took some little time for the lawyers to pass formally for the benefit of the company. The net result therefore was that the directors had been in charge of the affairs for only some three or four months of the period under discussion. It was a matter of common knowledge that during the year there was no very great stimulation of trade and that there were no large enterprises which came under the kind of work in which Johnson and Phillips had been specially successful in the past. It was, therefore, a matter of congratulation that the result obtained had come wholly and solely from the daily and ordinary business of the house and from no special or remarkable opportunities to make lucrative contracts. They had had the most ample assistance from Mr. Johnson, and at all times his assistance with suggestions as to the method of and conduct of the business, and the managing directors had assisted the directors in every possible way to get to the bottom of the company's affairs. The result for the year ended December 31st last was a net profit of £32,064. After paying directors' remuneration, debenture interest and reserve for debenture sinking fund, there was £21,938 available for distribution. They were not allowed to divide the net profits which were realised before the company's formation, so there remained £11,769 for division among the shareholders, leaving a balance in hand of earned profits of £10,169. In the opinion of the directors, the proper thing to do with that was to write off that amount promptly from the company's books, and they had, therefore, applied £10,000 to the reduction of the patents item—an item which was always a doubtful one in the views of shareholders—reducing it to only £5,900, and they had also written off the formation expenses of the company. It might be taken as absolutely correct that they had made every provision they possibly could to keep the company on as conservative a basis as possible, and he would like also to state, what had been stated in the report, that there was naturally a long period of more or less difficulty in knowing just what might happen with Johnson & Phillips during the process of re-organisation, and the establishment of the limited company. They were the more glad that the conservative policy had been followed in this matter since the questions had arisen which came from the late fire at the company's works. It was perfectly true that the damages from that fire were amply protected by insurance, but at the same time it had given rise to a great many questions as to what should be the proper course for the company at the present time. Had the fire not occurred at the moment it did, they would have adopted, and been in course of carrying out, various schemes for the extension of the works, and for putting them upon an absolutely modern mechanical manufacturing basis. Inasmuch as the fire occurred when it did, none of that work was at the present moment of use to them, and it was now before the directors to decide upon a number of schemes as to how best the company could take advantage of the present condition of affairs, and place the works upon a thoroughly modern standpoint. He presumed that would be a large part of the matter they would report to the next meeting. During the past year various large orders for the equipment of cable-ships for foreign powers, and equipment of cable works in foreign countries, had been received. None of those orders had come within the purview of the period under discussion, but they would enter into the coming year's balance-sheet. He thought they could safely say that everything had gone as well as they could reasonably expect, and that the prospects for the coming year were very much better than they were for the past.

Mr. J. D. Bonner seconded the adoption of the report, and it was carried.

Sir Hy. Benbow proposed the re-election of Mr. J. D. Bonner as a director, and Mr. J. Macgregor (managing director) seconded, and this was agreed to.

The dividend resolution proposed by the Chairman, and seconded by Mr. F. S. Paterson (managing director), was carried, and the auditors were re-elected.

Mr. Claud Johnson moved a vote of thanks to the directors, and said that he hoped he might continue to be of some use to them in the future. The conduct of the business had been in his hands as sole proprietor for a large number of years—in fact, ever since it was formed. It had naturally been his principal life work. He found it rather difficult to keep his hands off when he was allowed to come into the City office. For the first seven or eight months of the year under review he had had more to do with the business than the present directors, and during that period a good deal of time was occupied in the various works in connection with the formation of the company. Work of that kind naturally distracted the thoughts and the attention of the staff from the ordinary business of the works, and therefore some considerable allowance might be made for the comparatively small amount of profit. He did not say that he was disappointed in the results; they were neither greater nor smaller than he anticipated. Whatever the results were, they reflected great credit upon the present directors.

Mersey Railway Co.

Mr. J. Falconer presided at this company's half-yearly meeting on Friday last, and in moving the adoption of the report (see Electrical Review, March 23rd), he referred to the long and devoted services of the two directors whom they had lost by death since the last meeting. The half-year's working showed that the receipts continued to increase (by £2,271). There was a development going on, not only as the result of the change from steam to electric traction, but the continued service was developing the railway travelling in the district, and probably developing the district itself. The development that had taken place since electric traction was adopted was very striking. During the last full year of steam working—1902—the passengers carried were 6,660,000. During 1905 the number was 11,083,000, an increase of 4½ millions. That was a very striking testimony to the public appreciation of the facility given. Taking one thing with another, they were giving the best train service afforded in the United Kingdom to any suburban traffic. It was quite true that their receipts had not increased in the same proportion, because among the facilities which they had given was a re-arrangement of the fares, adjusting them to suit the traffic. They had, to some extent, reduced the difference between the first and third-class fares with results which were very promising. He thought the increase in first-class passengers in 1905, as compared with 1902, was just about 100 per cent., and they hoped that would go on, and that

the reduction in the fares would be more than compensated by the development of the traffic. Really one had to repeat it every half-year, but the important question for the company was to do everything it possibly could to develop the traffic and the district which it served. They had to enable the crowded population of Liverpool to find suitable residences in the Wirral district of Cheshire, a residential district which was unsurpassed. The chairman went on to tell the shareholders of the steps taken to introduce motor-omnibuses for certain purposes, and the injunction against them by the Birkenhead Corporation. He also referred to the company's Bill in Parliament. Both of these matters have been frequently reported in our pages of late. They had been able to satisfy the Liverpool Corporation, and all the surrounding districts of Birkenhead were entirely in favour of the omnibuses. The only opponent that appeared in Committee was the Birkenhead Corporation, but the Committee decided that the company should have the right to run the 'buses, and passed the Bill. It would now proceed to the House of Commons, and he was hopeful that before it reached there the Birkenhead Corporation would reconsider their position, and take a larger view of the interests of their community. The better the facilities that could be given the better it would be for everyone, and the town of Birkenhead would develop, bringing good also to Liverpool and its inhabitants.

The report was adopted, and the retiring director and auditor were re-elected.

Northern Counties Electricity Supply Co.

The annual meeting was held on the 22nd inst. Sir John D. Milburn, in moving the adoption of the report (see Electrical Review, March 23rd), said the company had made very considerable progress during the year. They had increased from 986,873 to 2,054,011 units, but this increase was rather disappointing to the board, and showed that the consumers were not ready to take the quantity that the company were prepared to supply. They should have supplied 200,000, or 300,000 units more, and that would have made an appreciable increase in the income, and a decrease in the costs. The most prosperous station they had was at Hebburn, with its sub-station at Felling. There they had connected consumers who would take from 3 to 3½ million units. Blyth had shown an improvement, and Hartlepool had given satisfaction. Of the units sold, 820,181 were for lighting, and 1,233,830 for power. The receipts for lighting came to £13,022, and those for power £6,305. He reported that the company issued at par £100,000 4½ per cent. first mortgage debentures in July last, which were largely over-applied for, and which were standing, he believed, at £2 per cent. premium that day.

The report was adopted, a 3 per cent. dividend agreed to, and the retiring directors were re-appointed.

Windsor Electrical Installation Co.

The tenth annual report of the directors for the year 1905 shows that during year the equivalent of 3,296 lamps (8-c.p.) were added, bringing the total to 34,321, of which 2,784 represent the motor-power. The capital expenditure during 1905 was £9,066, making £77,447. More than half of this additional capital expenditure was necessary to cover the cost of the buildings, machinery and mains to supply Old Windsor, and the remainder consisted principally of expenditure on new mains in Windsor and Eton.

The nominal share capital was increased by the creation of 5 per cent. cum. pref. shares of £1 each, and an issue of 20,000 of these shares was made to the shareholders at a premium of 1s. per share, the whole of this issue being taken up. The revenue from the lighting department was £11,510, and the profit on this department was £4,600, against £4,500 the previous year. The installation department had not worked satisfactorily, and the result was a loss on the year's trading of £654. £930 is to be added to the depreciation renewal and reserve fund, which is now £11,000. An interim dividend of 2½ per cent. has already been paid on the ordinary shares, and the directors recommend a further dividend at the same rate, making 5 per cent. for the year, and carrying forward sufficient to meet the dividend on the preference shares. The directors obtained the provisional order for Old Windsor, and the supply of current has already been commenced. The applications from the new district are very promising, and should assist materially in improving the revenue. The application for Clewer was abandoned owing to opposition from the Clewer Parish Council.

Buenos Ayres and Belgrano Electric Tramways Co.—The revenue account for the year 1905 including £2,086 brought forward from the previous year, shows an available balance of £77,885. Debenture charges absorb £28,260, there is put to renewals fund £9,000, and preference dividends require £20,250. Out of the balance of £20,375 the directors recommend the payment of a dividend of 3s. per share, free of income-tax, on the ordinary shares being at the rate of 3 per cent. per annum, carrying forward £5,375 to next account. The transfer books are closed until April 5th.

Anglo-Argentine Tramways Co.—The balance at the credit of net revenue account on December 31st, 1905, including £5,922 brought forward from 1904, and after deducting £50,000, which has been carried to depreciation renewal funds, amounts to £261,538. The directors recommend the payment of a final dividend on the ordinary shares of 5s. per share, free of income-tax, which, with the interim dividend of 3s. per share paid in October, will make 8s. per share, or 8 per cent. for the year, carrying forward £10,214.

Stock Exchange Notices.—Application has been made to the Committee to appoint a special settling day in and to grant a quotation to—

Madras Electric Supply Corporation, Ltd.—10,000 shares of £5 each, 10s. paid.

And to allow the following to be quoted in the Official List—

Madras Electric Supply Corporation, Ltd.—Scrip (fully and partly paid) for £250,000 5 per cent. construction debenture stock.

Oldham, Ashton and Hyde Electric Tramway, Ltd.—The report for 1905 states that the total revenue amounts to £30,137, and the expenditure (including £1,600 for debenture interest) to £23,851, leaving a profit of £6,285, which, added to £142 brought forward from the previous account, makes an available balance of £6,427. The directors propose to place to depreciation and reserve fund £751, bringing it up to £10,500. After paying a 6 per cent. dividend on the ordinary shares, £176 is carried forward.

United Alkali Co.—The directors' report for the year 1905 shows net profits amounting to £487,264, being an increase of £75,000 over 1904. After paying debenture interest and other charges and including the amount brought forward from the previous year, there was an available balance of £334,584. £15,000 is to be transferred to debenture redemption account, £40,000 added to the reserve fund, increasing it to £100,000, and £50,000 placed to depreciation reserve fund. After paying the 7 per cent. preference dividend £41,706 is carried forward.

Sir W. G. Armstrong, Whitworth & Co.—Interim dividend on the ordinary shares at the rate of 10 per cent. per annum.

British Electric Transformer Co.—The directors' report for 1905 states that, after paying all manufacturing costs and the expenses of administration, there remains a net profit of £10,228, which, with the amount brought forward, makes a total available balance of £12,690. The board recommend that there be placed to depreciation reserve £1,500, to reserve fund £2,000, to preliminary expenses written off £1,500, to payment of preference dividend £1,730, and to a dividend of 7½ per cent. on the ordinary shares, £5,166, carrying forward £794.

W. T. Glover & Co.—The annual report shows a balance of £6,411 standing to the credit of profit and loss account. Business generally, the directors say, has shown some improvement during the year, and they have been able to strengthen the financial position of the concern by setting aside £17,790 for the creation of an investment contingency fund, which, with £8,000 transferred from the reserve, and £793, the profit derived from the realisation of investments, amounts to £26,084. The investments of the company are largely in concerns allied with electrical industries, and were made some years ago. Being unquoted securities, it is not possible to establish their value accurately; but by the creation of this fund, the directors believe they have made full provision for any loss that may arise. The directors purpose issuing the £100,000 5 per cent. second mortgage debentures, already authorised by the preference shareholders, for the purpose of repaying the overdraft at the bank and the temporary loans, the time for which they were originally advanced having long since expired. The directors' first consideration having been to strengthen the company's financial position, they do not recommend the payment of a dividend.

Newquay Electric Light and Power Co.—This company held its statutory meeting on 20th inst. Great progress was reported.

Newmarket Electric Light Co.—The annual meeting was held on Monday last week, Mr. G. H. Verrall, J.P., presiding. The seventh annual report stated that during the past year 1,910 8-c.p. lamps had been connected to the mains, making the total 20,100 lamps. The directors had decided to offer to supply current for lighting for trade purposes at a flat rate of 6d. per unit, as from January 1st last. Many of the consumers had elected to be supplied on this basis in future. The profit on the year's working, added to £135 brought forward, amounted to £2,231. Debenture interest amounted to £710, and the directors recommended that a dividend of 4½ per cent. be paid; that £350 be placed to reserve for renewal of plant, and a balance of £116 carried forward. The Chairman said that the steady progress of the company had been continued, and the receipts showed an increase of £209 as compared with 1904. Since it was desirable that the reserve fund should be strengthened, the directors were unable to recommend that a dividend of more than 4½ per cent. should be paid. Out of the reserve, which would amount to £1,100, they would probably be called upon to expend nearly £900 on renewals during the present year. The report was adopted.

Melton Mowbray Electric Light Co.—The annual meeting was held on Tuesday last week, Mr. W. J. New presiding. The directors' report observed that substantial progress had been made by the company during the year, the lamps connected having increased from 13,543 to 15,434, being an increase of 14 per cent. The total number of consumers was now 501. The revenue for the year, after adding £103 6s. 1d. brought forward, amounted to £1,471, and after providing for interest on debentures, loans, &c., there remained a balance of £411 available for distribution. The directors recommended that a dividend be declared of 2½ per cent. leaving a balance of £10 to be carried forward.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	*
Aberdeen	Mar. 24	2,301	+ 76	43	57,825	— 735	14·4	..
Ayr	,, 17	371	— 8	43	12,542	— 66	8	..
Bath	,, 21	1,275	+ 67	12	7,619	+ 1,112	13	..
Belfast	,, 23	5,938	+1,301	12	34,869	+ 8,108	40	+ 6½
Birkenhead	,, 25	1,913	— 44	51	52,418	— 546	13·5	..
Blackburn	,, 21	1,713	— 8	51½	49,011	+ 2,671	13·75	..
Blackpool Corp.	,, 22	744	— 43	51	49,304	+ 2,037	11·87	..
,, —Fleetw'd	,, 24	409	— 25	12	2,241	— 34	8·25	..
,, —Lytham	,, 22	337	— 17	20	3,059	+ 268	7½	..
Bolton	,, 25	3,695	+ 105	52	98,948	+ 5,176	26	+ 1
Bournemouth	,, 21	2,550	+ 535	50½	71,177	+16,884	17·4	+ 7½
Bradford	,, 24	7,999	+ 84	51	220,096	— 1,826	53	..
Brighton	,, 25	1,367	— 327	52	49,520	..	9·5	..
Bristol	,, 23	9,250	+ 40	..	..	..	28·5	..
Brit. Elec. Trac. Co								
Airdrie	Mar. 16	413	+ 19	11	2,318	+ 216	8·5	..
Barrow	,, 16	431	+ 33	,,	2,160	+ 191	5·37	..
‡Birmingham (City)	,, 16	10,638	— 571	,,	55,573	— 1,470	14·5	..
Birmingham (Mid.)	,, 16	2,811	— 736	,,	14,519	— 3,724	12·25	..
Devonport	,, 16	817	— 8	,,	4,333	— 222	8·85	..
Dudley—Sto'rb'ge	,, 16	1,549	+ 23	,,	7,998	+ 349	21·25	..
Gateshead	,, 16	1,859	+ 89	,,	9,823	+ 524	11·25	..
Gravesend, N'fleet	,, 16	408	+ 15	,,	2,098	+ 106	6·5	..
Greenock	,, 16	1,122	+ 57	,,	6,043	+ 481	7·25	..
Hartlepool	,, 16	514	+ 13	,,	2,701	+ 125	6·72	..
Leamington	,, 16	283	+ 115	,,	1,404	+ 464	3	..
Merthyr	,, 16	377	+ 6	,,	1,868	— 11	2·9	..
‡Metropolitan	,, 16	5,955	+2,239	,,	29,577	+ 9,543	22	..
Middleton	,, 16	581	+ 51	,,	2,983	+ 236	8·5	..
Oldham — Ashton	,, 16	1,052	+ 52	,,	5,430	+ 254	9·13	..
Peterborough	,, 16	201	— 10	,,	1,030	— 47	5·31	..
Potteries	,, 16	3,579	+ 220	,,	18,612	+ 1,202	29	..
Rothesay	,, 16	89	..	,,	516	+ 37	2·75	..
Southport	,, 16	451	— 12	,,	2,467	+ 27	8·17	..
South Staffs.	,, 16	1,588	+ 248	,,	8,225	+ 1,363	13·87	..
Swansea	,, 16	1,443	+ 411	,,	7,624	+ 2,674	5·5	..
Tynemouth	,, 16	333	— 22	,,	1,713	— 96	3·75	..
Weston-s-Mare	,, 14	65	+ 7	,,	288	+ 4	3	..
Wolverhampton D.	,, 16	780	+ 75	,,	4,000	+ 366	14·75	..
‡Worcester	,, 16	469	— 65	,,	2,503	— 182	5·75	..
Yorks. Wool. Dist.	,, 16	1,659	+ 518	,,	8,678	+ 2,937	17	..
Miscellaneous	,, 16	3,653	+ 10	,,	18,856	— 25	..	..
Burnley	,, 24	2,098	+ 23	..	..	..	7·5	..
Burton-on-Trent	,, 25	516	— 99	51	15,427	— 1,781	8·5	..
Bury	,, 18	1,713	..	50	38,305	..	10·5	..
Cardiff	,, 17	3,819	+ 50	50	101,157	+ 348	15·8	..
Carlisle	,, 24	308	+ 24	12	1,873	+ 159	..	..
Chatham and Dist.	,, 22	1,167	— 88	12	6,697	— 129	9·3	+ 8
Colchester	,, 7	327	— 5	31	5,660	..	7½	+ ½
Cork	,, 22	873	+ 12	12	4,884	+ 18	9·9	..
Darlington	,, 24	379	+ 7	51	10,299	..	4·87	..
Darwen	,, 23	444	+ 10	51	12,288	+ 767	4·36	..
Dover	,, 24	344	+ 2	51	11,150	+ 106	4·75	+ 1½
Dublin	,, 28	9,190	— 82	12	53,468	+ 1,616	48·5	+ ·5
Dundee	,, 21	1,817	+ 250	44	41,443	+ 3,875	12·5	..
East Ham	,, 24	1,564	+ 62	51	42,030	+ 5,874	8	+ ½
Exeter	,, 23	443	..	51	13,989	..	4·25	..
Glasgow	,, 24	30,955	+1,618	42	653,947	+43,031	78	+ 4·5
†Gloucester	Feb. 21	221	+ 12	..	..	..	15	..
Halifax	Mar. 21	2,621	+ 61	51	78,346	+ 5,851	37	+ 1·5
Hastings	,, 23	700	..	..	..	..	..	..
Huddersfield	,, 24	2,590	+ 146	51	69,325	+ 4,131	28	..
Hull	,, 24	4,358	+ 52	51	113,470	+ 2,280	13	..
Ilford	,, 10	850	+ 142	49	22,678	+ 1,124	6·37	..
Ilkeston	,, 21	225	— 9	51	5,983	— 669	3·5	..
Ipswich	,, 24	644	— 58	51	21,048	— 1,921	10·5	..
Isle of Thanet	,, 24	470	— 137	12	2,811	— 81	11	..
Kilmarnock	,, 24	280	— 12	45	6,943	..	4·12	..
Kirkcaldy	,, 21	397	— 9	..	..	..	7·5	..
Lan'kshire Trm. Co.	,, 22	1,588	+ 321	12	9,729	+ 2,187	12·5	+ 3·9
Leeds	,, 17	11,326	+ 502	51	298,103	+ 9,727	89·5	+ 8
Leicester	,, 24	4,108	+ 242	12	23,938	+ 2,897	..	..
Leith	,, 17	862	..	43	16,140	..	6	+ 1
Liverpool	,, 17	20,815	+ 889	11	111,380	+ 4,449	104	+ 1
L.C.C.	,, 10	29,740	+4,957	49	718,539	+95,052	50·5	+ 3·8
Lowestoft	,, 24	205	— 41	26	3,351	— 98	3·5	..
Manchester	,, 24	24,528	+ 136	51	653,160	+33,461	84	..
Nelson	.. ..	..	..	..	..	..	..	..
Newcastle	,, 24	7,295	+ 39	51	193,235	+ 4,574	25·5	..
Newport	,, 17	1,110	+ 64	24	13,115	+ 1,009	14·5	+ 1·5
Northampton	,, 23	718	— 41	51	21,351	+ 5,276	5·5	..
Oldham	,, 24	3,001	+ 503	52	84,148	+18,595	23·75	+ 1·6
Pontypridd	,, 24	315	..	51	8,131	..	3·5	..
Portsmouth	,, 24	2,750	— 431	51	95,838	+ 1,439	14·5	..
Preston	,, 21	1,248	+ 152	..	..	..	10	..
Reading	Feb. 22	1,072	+ 18	47	29,267	— 498	7·5	..
Rochdale	Mar. 24	1,601	+ 670	51	40,008	+25,645	21·3	+ 5·8
Rotherham	,, 22	877	+ 51	51	23,095	+ 32	9·33	..
Salford	,, 5	8,187	+ 809	49	207,764	+12,362	38·9	..
Sheffield	,, 25	9,671	+ 362	52	256,438	+15,872	35·75	-1·5
Southampton	,, 21	1,649	— 53	24	21,076	+ 133	..	..
Southend-on-Sea	,, 21	482	— 9	51	18,167	+ 1,096	6	..
Stalyb'dge,Hyde,&c.	,, 17	1,225	+ 271	50	31,561	..	21	..
‡Stockport	,, 16	747	+ 319	50	38,071	+11,304	15·5	+ 4
Sunderland	,, 25	2,377	+ 134	51	66,713	+ 3,189	10·87	..
Swindon	,, 21	326	— 31	51	9,759	..	4·4	..
†Tyneside	,, 7	375	+ 24	10	3,274	+ 112	8·87	..
Warrington	,, 15	705	+ 100	52	17,126	+ 1,203	6·37	+ ·25
West Ham	,, 22	3,819	+1,475	51	94,191	+40,495	14·7	+ 4·9
Wolverhampton	,, 21	1,455	..	..	..	..	10	..
Yorks. W. Riding	,, 25	1,407	+ 57	12	8,119	..	..	..
Cen. London Rly.	,, 24	13,949	— 146	12	83,641	— 2,512	6	..
City & S. Lon. Rly.	,, 25	5,957	+ 230	12	35,880	+ 200	6·25	..
Dublin-Lucan Rly.	,, 23	207	— 4	12	1,058	— 74	7	..
G. N. and City Rly.	,, 24	3,686	+ 221	12	21,859	+ 781	3·5	..
L'pool Overh'd Rly.	,, 25	2,728	— 297	12	16,620	— 1,043	6·65	..
Mersey Railway	,, 24	3,373	+ 205	12	20,327	+ 959	4·5	..
Metropolitan Rly.	,, 25	33,412	— 846	12	201,494	— 2,694	70·5	..
Met. District Rly.	,, 25	16,076	+ 996	12	97,461	+ 5,341	24	..
Anglo-Argentine	,, 25	30,579	+2,938	12	178,269	+18,536	43	..
§Brit. Columbia Rly.	Feb.	17,997	+2,937	34½	161,201	+33,987	..	..
†Bu'n's A'r's E.T. Co.	,, 24	1,413	+ 293	8	11,244	+ 2,678	24	..
†Bu'n's A'r's-Blgr'no	Mar. 18	3,658	+ 200	12	38,768	+ 3,533	..	..
Calcutta	,, 24	5,709	+ 572	..	..	..	..	..
§Cape Electric T. Ld.	Feb.	15,906	..	..	..	..	..	..
§Geneva	,,	6,231	+ 255	..	..	..	..	..
Perth (W.A.)	Mar. 23	2,957	+ 220	12	18,410	+ 904	24·25	+ 5½

* Compared with the corresponding period of 1905. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Wednesday Evening.

With the commencement of a new quarter, it is hoped that there may be some revival in Stock Exchange business. Nobody can ever say that the House is downhearted for a couple of consecutive days, and it can always find ground for hope: next week, if trade continues inactive, we shall be hearing that the animation is merely postponed until after Easter. But—to our muttons.

Money being fairly plentiful at about 5 per cent. for short loans, investment should be thereby stimulated. It seems, however, as though the people with capital were better content to lend the cash upon security than to employ it in more permanent fashion. Hence it may be accurately surmised that our price-lists have a very insipid tale to tell, movements generally being of slight importance.

Much interest, however, is fixed upon the erratic movements of Metropolitan Railway Consolidated and District Ordinary stocks. Since last we wrote "Mets" have been 76½ and Districts 27½. Both are now higher at 78 and 28, support having been accorded at the stage of acute flatness. The vagaries of the lines, and especially those of the District, are excellent subjects for jesting upon by those not compelled to make use of the two tunnels. Central London stocks fail to benefit by the eccentricities of the District, although the latter has but to maintain its growing fame for fires, breakdowns and such like for passengers to be driven into the Twopenny Tube, the chief fault to be found with which is the sleepy heaviness of the atmosphere. By the way, we wonder when the City and South London will ask for the additional capital, whose necessity was hinted at not very long ago.

Falling 3 points, British Electric Traction 5 per cent. first Debenture is now 115½. At this, it pays little less than the second 4½ per cent. Debenture, also a perpetual stock. The Ordinary keep fairly firm at 7⅞, and the Preference are 9¾. Buenos Ayres and Belgrano Ordinary fell ⅛ to 3½ upon the reduced dividend, but Anglo-Argentines showed no change, the latter remark also covering Capes, Dublins, and Metropolitan Electric Tramways issues. Calcutta Trams lost ⅛, and London United Preference rose ¼, both to 9¾. Manufacturing shares are quiet, British Aluminium Preferences both putting on ¼, and Callender's Preference ⅛, while Willans & Robinson Ordinary at 2 are ¼ lower, after their fall of last week.

Though the London County Council has piloted its Supply Bill past the second reading, electricity shares are more or less indifferent at the fulfilment of what was expected to occur. Metropolitan Ordinary are down ¼, for some esoteric cause, and many shares are *ex* dividend to-day, amongst them being Citys, Countys, Newcastle, Urbans and others. Edmundson's Preference have begun to follow the drooping example set by the Ordinary shares. Wider prices for Charing Cross Ordinary give the shares the appearance of being ¼ up at 5¼. Westminster new Preference are called 28s. 9d. for the partly-paid.

Persistent demand for Great Northern Telegraph shares has raised the price 30s. this week, and it now stands at 40½. The shares are of the nominal value of £10 each, and thus command a premium of over 300 per cent. "It is not surprising," we heard a broker say the other day; "the shares are certainly cheap." This constitutes the chief change worthy of mention, but the Anglo-American Telegraph group has fallen about ½ per cent. for each stock, notwithstanding the dividend estimates of 30s. per cent. on the Deferred stock; the declaration is not due until next January. Eastern Telegraph Ordinary dropped a point to 147½, and Eastern Extension shares were put down ¼ to 15. Falls have also occurred in Western Telegraph and West India and Panama Second Preference. Marconi's are up another ⅛ to 1⅜, upon the issue of the report and the favourable meeting, while the new shares have improved to about 6s. premium. Globe Ordinary and Preference declined ⅛, in sympathy with the duller tone of the Eastern group.

Amongst Telephones, National Third Preference are ¼ easier at 5⅜, and the Preferred is not quite so good. But Oriental 4 per cent. debenture at 99 has risen a point.

Canadian Iron Smelting.—According to the Canadian Press, the experiments carried out at Sault Ste. Marie on behalf of the Government have been entirely successful. Dr. E. Haanel, Superintendent of Mines, reports the successful smelting of magnetite and desulphurisation of pig, and states that 40 tons of pig have been produced.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years.				Closing Quotations March 21st.	Closing Quotations March 28th.	Business done week ended March 28th, 1906.		Rise + or Fall −
			1902.	1903.	1904.	1905.			Highest	Lowest.	
17,700	African Direct Telegraph, 4 % Debs...	100	4 %	4 %	4 %	4 %	98½ –101½	98½ –101½	..	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3⅜ — 4½	3⅜ — 4½	..	..	..
155,600‡	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	83 — 88	83 — 88	84½	84	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	2½%	3½%	65¼ — 67½	65½ — 67½	..	..	..
8,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6¼%	6 %	113 –114	112½–113¾	114	112⅞	— ½
8,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	⅛%	19⅜ — 19⅝	19⅛ — 19⅜	19⅜	19⅛	— ½
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	101 –103 xd	101 –103	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	..	8 — 8⅛	8 — 8⅛	8⅜	..	..
1,982,850‡	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	97½ — 99½	96½ — 98½ xd	98⅜	98½	..
16,000	Cuba Telegraph	10	6¼%	10 %	5 %	5 %§	8¾ — 9	8⅝ — 9	8⅞	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %§	17 — 18	17 — 18	..	..	..
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜ — 3⅝	3⅜ — 3⅝ xd	..	..	..
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 %	8¾ — 9	8⅝ — 9 xd	..	..	..
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 –103 %	100 –103	..	..	..
60,710‡	Direct United States Cable	20	3½%	3 %	3½%	3⅜%	15¼ — 16	15¼ — 15⅝ xd	15⅝	15⅜	..
70,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200,R.	100	4½%	4½%	4½%	4½%	100 –102	100 –102	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	5 %§	147 –150	146 –149	148½	147	1
1,848,772	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%§	90 — 92	90 — 92	91⅜	90¼	..
800,000	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %§	107⅛–109½	107 –109	108⅜	107⅜	— ½
752,400	Eastern Extension, Australiasia, and China Tele.	10	7 %	7 %	7 %	6 %§	15 — 15⅛	14⅞ — 15⅛	15⅛	14⅝	— ¼
800,000	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %§	105 –107	105 –107	106⅛	..	..
1,983,333	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99 –101	99 –101	..	..	..
1,966,667	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	101 –103 %	101 –103	..	..	..
200,000‡	Globe Telegraph and Trust	10	£3	5½%	5⅝%	5 %	11¼ — 11⅝	11 — 11½	11½	11⅛	— ⅛
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14½ — 15	14⅜ — 14⅝	14⅝	14⅜	— ⅛
180,887	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	24%	38 — 40	38½ — 41½	40½	38½	+1½
150,000	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100 –102	100 –102	..	..	..
42,300	Indo-European Telegraph	25	10 %	10 %	13 %	5 %	57 — 59	57 — 59	57	..	..
17,000	Marconi's Wireless Telegraph	1	..	..	..	..	1⅛ — 1⅜	1⅛ — 1⅛	25/7½	23/6	+ ⅛
251,127	Monte Video Telephone Co., Ltd. Ord.	1	3 %	3 %	4 %	..	¾ — 1	¾ — 1⅛	20/-	..	+⅛
72,680	Do. do. do. 5 % Pref.	1	5 %	5 %	5 %	..	¾ — 1	¾ — 1	..	..	..
86,492	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	110 –111	109 –111	110⅜	109½	— ½
1,983,333	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	112 –114	112 –114	113¼	112¼	..
1,966,667	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	12 — 14	12 — 14	..	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10¾ — 12½	10¾ — 12¼	..	..	..
15,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅜ — 5⅝	5⅛ — 5⅜	5⅜	5⅛	— ⅛
250,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	99 –101	99 –101	..	..	..
2,000,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 –105	103 –105	104	103⅜	..
1,689,593	Oriental Telep. and Elec. 1 to 171,504,fully paid	1	6 %	6¼%	6¼%	6 %	1⅛ — 1⅜	1⅛ — 1⅜	25/-	..	..
179,313	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..
50,000	Do. do. do. 4 % Red. Deb. Stock	100	..	..	..	4 %	97 — 99	98 –100	99	98½	+1
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 –102	99 –102	..	..	..
100,000	Reuter's	8	5 %	5 %	5 %	5 %§	7¼ — 7⅜	7¼ — 7⅜	7⅜	..	..
11,839‡	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	..	4½%	103 –106	103 –106	..	..	..
60,000	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	128 –131	128 –131	..	..	..
3,201	United River Plate Telephone	5	7 %	8 %	8 %	..	7¼ — 7⅜	7¼ — 7⅜	7⅜	7⅛	..
70,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5¼ — 5⅜	5¼ — 5⅜	..	..	..
40,000	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	110 –112	110 –112	..	..	..
179,947	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	9⅜ — 10¼	9⅜ — 10¼	10	..	..
15,609‡	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	..	⅜ — ½	⅜ — ½	..	..	..
30,008	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	100 –102	100 –102	..	..	..
150,000	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	5 %	14½ — 15	14¼ — 14⅝ xd	14½	..	..
207,930	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	100 –102	100 –102	..	..	..
75,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	102 –104	102 –104	102½	..	..
563,380	West India and Panama Telegraph	10	Nil	Nil	Nil	..	⅜ — ½	⅜ — ½	9/6	8/6	..
88,321	Do. do. 6 % Cum. 1st Pref.	10	7 %	7 %	6 %	6 %	8¼ — 8⅜	8¼ — 8⅝	..	..	..
84,563	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	6¼ — 7⅛	6 — 7	6¼	..	— ⅛
4,669	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	100 –103	100 –103	..	..	..
80,000‡											

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

170,000	Anglo-Argentine Trams, 260,008 to 430,007	5	..	..	8 %	8 %	9 — 9¼	8⅞ — 9¼	9⅜	9	..
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5¼ — 6⅛	5¼ — 6⅛	6⅜	6	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	141 –144	141 –144	..	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	104 –106	104 –106	..	..	..
800,000	Babcock & Wilcox, 1 to 580,000	1	..	17 %	20 %	16 %‖	3⅞ — 4⅛	3¾ — 4⅛	81/3	78/11½	..
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1⅞ — 1⅞	1⅞ — 1⅞	..	..	..
38,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	..	..	2⅛ — 2⅛	2⅛ — 2⅛	..	..	..
40,000	Do. do. 7 % Cum. Pref...	5	Nil	Nil	Nil	3/6	6 — 6⅛	6⅛ — 6⅜	..	..	+ ⅛
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	Nil	3/-	5 — 5⅛	5⅛ — 5⅜	..	..	+ ⅛
20,000	Do. do. 4 % Funding Certs.	5	..	..	..	..	2⅜ — 3⅛	2⅜ — 3⅛	..	..	..
300,000‡	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	98 –102	100 –104	..	..	+2
300,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	..	120 –123	120 –123	..	..	..
300,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	..	110 –113	110 –113	..	..	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	107 –110	107 –110	107⅜	..	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	103 –105 %	103 –105%	104⅜	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	102 –105	102 –105	..	..	..
133,301	British Electric Traction	10	8 %	6 %	6 %	..	7⅛ — 7⅜	7⅛ — 7⅜	7⅜	7⅛	..
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %§	9¼ — 10	9¼ — 10	9⅝	9¼	..
1,415,423‡	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %§	117 –120	111¼–114½ xd	117	..	..
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	97 — 99	97 — 99	..	..	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6⅞ — 7⅛	6¾ — 7 xd	6⅞	..	..
100,000	Do. do. 5 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅞ — 6⅛	5⅞ — 6⅛	5¹⁵⁄₁₆	5⅞	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	103 –106	103 –106	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	96 — 98	96 — 98	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1⅞ — 2⅛	1⅞ — 2⅛	43/-	42/9	..
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	80 — 85	80 — 85	..	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	⅜ — ½	⅜ — ½	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	2½%	¾ — 1	¾ — 1	20/-	18/9	..
150,000	Do. Non-cum. 6 % Pref.. ..	2	6 %	6 %	6 %	6 %	1¾ — 2	1¾ — 2	35/-	..	..
125,000‡	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	97 — 99	97 — 99	..	..	..
125,000‡	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	82 — 84	82 — 84	..	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3 %	3⅜ — 3⅝	3⅜ — 3⅝	76/3	70/-	— ⅛
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5¾ — 6⅛	5¾ — 6⅛	6	..	..
27,500	Do. "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	5¼ — 5⅝	5¼ — 5⅝	..	..	..
317,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	106 –108	106 –108	..	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	102 –105	102 –105	..	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	7 %§	9⅜ — 10⅛	9¼ — 10	9⅜	..	— ⅛
32,610	Do. 105,001 to 137,610	5	..	..	..	3d.	9 — 9¼	9 — 9¼	9⅛	9 1/16	..
350,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4 %	4½%	106 –108	106 –108	107	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	10%	10¾ — 11¼	10¾ — 11¼	..	..	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅝ — 6	5⅝ — 6	6	5⅝	..
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108½–110½	108½–110½	..	..	..
491,222	Cape E. Trams., 1 to 491,222	1	..	15 %	10 %	5 %§	⅝ — ¾	⅝ — ¾	..	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	..	1 1/16 — 1 1/8	1 — 1⅛	21/-	..	— 1/16
230,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	95 –100	95 –100	..	..	..
1,939,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	91 — 93	91 — 93	92¼	91¼	..
530,316	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	103 –105	102 –104	102⅝	..	–1
530,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	82 — 85	82 — 85	83⅜	82¼	..
1,480,000	City and South London Railway	Stock	3½%	2⅞%	2⅞%	1⅞%	41 — 43	41 — 43	42	41	..
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	2½%	2½%	..	2 — 2¼	2 — 2¼	42/6	..	..
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	95 — 98 %	95 — 98	..	..	..

* period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued).*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Mar 21st.	Closing Quotations Mar 28th.	Business done week ended Mar. 28th, 1906		Rise + or Fall—
		†	1902.	1903.	1904.	1905.			Highest	Lowest.	
52,000	Dick, Kerr & Co., 1 to 52,000	5	..	..	10 %	..	8⅞ — 9¼	8⅞ — 9¼	..	..	..
61,000	Do. do. 6 % Cum. Pref., 1 to 61,000	5	..	6 %	6 %	6 %	6 — 6⅛	6 — 6⅛ xd	6 7/8	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½ %	4½ %	4½ %	104 —106	104 —106	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5½ %	6 %	6 %	13⅜ — 14⅜	13⅜ — 14⅜	..	..	..
59,987	Do. 6 % Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14½ — 15½	14½ — 15½	..	..	..
68,400	Do. 4 % Debs.	100	..	4 %	4 %	4 %	99½ —100½	99½ —100½	..	..	..
800,000	Do. 3¼ % "A" Debs.	100	..	3¼ %	3¼ %	3¼ %	100 —100½	100 —100½	..	..	..
800,000	Do. 3¼ % "B" Deb. Stock	100	..	3¼ %	3¼ %	3¼ %	97 — 97½	97 — 97½	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	Nil	2½ % §	..	1⅜ — 1⅝	1⅜ — 1⅝	35/-	..	..
17,139	Do. "A" shares, 01—017,139	5	Nil	Nil	2½ % §	..	2½ — 3	2½ — 3	..	..	..
844,023‡	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	86¼	86	..
100,000‡	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	92 — 97	90 — 95 xd	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	..	⅜ — ⅝	⅜ — ⅝	13/16	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	..	2 — 2¼	2 — 2¼	43/9	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	89 — 92	89 — 92	..	..	..
25,900	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	9⅜ — 9⅞	9⅜ — 9⅞	9 7/8	9½	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	94 — 98	92 — 96 xd	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %	4¼ — 4⅝	4¼ — 4⅝	..	..	..
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10⅝ — 11¼	10⅝ — 11¼	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	102 —103	102 - 104	..	..	+ ½
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	15%	12½ — 13½	12½ — 13½	12 13/16	..	..
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5¼ — 5⅝	5¼ — 5⅝	..	..	..
41,978	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	.. — ..	108 - 110	..	..	..
108,022	Do. do. Scrip. £0 % paid	..	..	..	..	..	.. — ..	57 — 59	..	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	5 %	10%	17½ — 18½	17½ — 18½	17½	..	..
800,000‡	Do. do. 4% 1st Mort. Deb.	100	4 %	4 %	4 %	4 %	99 —102	.. — ..	..	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	1⅛%	1½%	Nil	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	6½ — 7	6½ — 7	..	..	..
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	3 %	7⅛ — 8¼xd	7 — 9	..	..	..
399,930	Do. do. 60,008 to 100,000 (£4 paid)	10	..	8 %	6 %	3 %	2 — 3 xd	2 — 3	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	9½ — 9⅞	9⅜ — 10	9⅞	9⅞	+ ⅛
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	95 — 98	95 — 98	97½	96½	..
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	..	3/16 — ¼	3/16 — ¼	..	..	..
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	15/16 — 1 1/16	15/16 — 1 1/16	19/6	19/-	..
350,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½%	4½%	104 —106	104—106	..	..	..
20,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000	5	..	..	6 %	6 %	5 — 5½	5 — 5½	..	..	..
24,500	Potteries E. Trc., 20,001 to 40 000 & 50,001 to 54,500	10	..	5 %	5 %	4 %	8½ — 9	8½ — 9	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	9 — 9½	9 — 9½	..	..	..
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	103 —106	103 — 106	..	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	15 %	32½ — 34½	32½ — 34½	..	..	..
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	100 —102	100 — 102	..	..	..
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	98 —100	98 — 100	..	..	..
640,000	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	3½%	98 —101	98 — 101	99	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	8½%	6 % §	..	..	2 — 2½	1¾ — 2¼	40/3	..	— ⅛
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	..	..	3½ — 4¼	3⅜ — 4¼	..	..	..
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	80 — 85	80 — 85	..	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5½%	4 ⅝% §	5½ — 5⅝	5½ — 5⅝	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	103 —106	103 —106	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	10 %	8½ — 9½	8½ — 9½	..	..	..
10,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	8½ — 9½	8½ — 9½	..	..	..
300,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	102 —105	102 —105	..	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %	4⅜ — 5¼	4⅜ — 5¼	..	..	+ ⅛
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4½ — 5	4½ — 5	97/6	..	..
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	4¼ — 4⅝	4¼ — 4⅝	..	..	..
40,000	Do. do. 1903	5	..	4½%	4½%	4½%	4¼ — 4⅝	4¼ — 4⅝	..	..	..
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —103	101 —103	..	..	..
44,486	Chelsea Electricity Supply, Ord.	5	4½%	5½%	6 %	6 %	5¼ — 5⅝	5¼ — 5⅝	5 1/8	..	..
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	107 —109	107 —109	10⅝	1 7/8	..
70,796	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	6 %	10⅜ — 11⅜	10½ — 11½ xd	11½	10⅜	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	13½ — 14½	13 — 14 xd	..	..	..
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	..	..	..
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
40,000	County of Durham Electrical Power, Ord.	2	4 %	4 %	£3 7 0	4 %	1⅞ — 2⅛	1⅞ — 2⅛ xd	..	..	..
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	5 — 5⅛	4⅞ — 5⅛ xd	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	5 %	8½ — 9⅛	8½ — 9⅛ xd	8⅝	..	..
30,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	12⅝ — 12⅞	11⅝ — 12⅛ xd	12	..	..
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	109 —112	109 —114	110⅛	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	101 —103	101 —103	102⅜	102⅛	..
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	5 ⅝% §	4 — 4¼	4 — 4¼	..	..	..
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	6 %	5¼ — 5⅞	5 — 5⅞	5⅞	5⅛	— ⅛
320,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	104 —106	104 —106	104	..	..
10,000	Folkestone, 1 to 10,000	5	..	5½%	5½%	5½%	5¼ — 5⅜	5¼ — 5⅜	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	5 — 5⅛	5 — 5⅛ xd	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
13,000	Hove, 1 to 13,000	5	..	8½%	8½%	9 %	8½ — 9	..	..	..	..
10,000	Do. New (£5 10s. paid)	£3	..	8½%	8½%	9 %	8⅝ — 8⅞	8½ — 9	..	..	..
37,303	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	98 —100	98 —101	..	..	+ ½
7,300	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	98 —101	98 —101	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12½%	12 %	10 %	9½ — 10½xd	9½ — 10½	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	4 %	2 — 2⅜	2 — 2⅜	45/-	42/6	..
60,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
874,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8⅜%	10 %	10 %	9 — 10	8½ — 9½ xd	9½	9⅛	..
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½%	4½%	4½%	4½%	5⅜ — 5⅝	5⅜ — 5⅝	..	..	..
220,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	110 —114	110 —114	..	..	..
250,000‡	Do. 3¾ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3¾%	3¾%	95 — 97	95 — 97	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	101 —103 %	101 —103	..	..	..
57,009	Newcastle-on-Tyne, 1 to 57,009	5	..	8 %	8 %	8 %	8 — 8¼	7⅞ — 8¼ xd	..	..	..
17,991	Do. 57,010 to 75,000	5	..	..	..	8 %	8 — 8¼	7⅞ — 8¼ xd	..	..	..
57,009	Do. 5 % Pref., 1 to 57,009	5	..	5%	5	5 %	6¼ — 6⅝	6 — 6⅜ xd	..	..	..
17,991	Do. 57,010 to 75,000	5	..	..	..	5 %	6¼ — 6⅝	6 — 6⅜ xd	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	7½%	13 — 14	13 — 14	..	..	..
64,000	Do. do. 4 % 1st Mort.Deb.	100	4 %	4 %	4 %	4 %	98 —100	98 —100	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	5	..	6½%	7 %	7 %	6½ — 7	6½ — 7	6⅝	..	..
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	99 —101	99 —101	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	12½%	9¼ — 10¼	9¼ — 10¼	..	..	..
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..
150,000‡	Do. do. 3¾ % Deb. Stock Red.	100	3½%	3½%	3½%	3¾%	96 — 98	96 — 98	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	4 %	2¼ — 2⅝	2¼ — 2⅝	..	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	76 — 80	76 — 80	..	..	..
65,000	South London Electricity Supply, Ord.	5	12½%	8 %	4 %	4 %	8¼ — 8⅝	8 — 8¼ xd	..	..	..
103,700	South Met. Elec. Lt. & Power (Ord.	1	Nil	Nil	Nil	2½%	⅜ — ⅝	⅜ — ⅝	..	..	..
85,368	*(Late Blackheath and Greenwich* 7 % Pref.	1	Nil	7 %	7 %	7 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..
148,292	*Dist. E.L.Co.)* 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	105 —108	103 —106 xd	..	..	..
50,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	4¼ — 4⅜	4¼ — 4⅜ xd	..	..	..
30,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5 — 5¼	4⅞ — 5¼ xd	..	..	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	104 —106	102 —104 xd	..	..	..
110,000	Westminster Electric Supply, Ord.	5	12 %	13½%	14 %	13 %	9½ — 10¼	9½ — 10¼ xd	10	9⅞	..
28,151	Do do. 4½ % Cum. Pref. (Originally 5 %—Red. to 4½ % from 31st Dec., 1905.)	5	5 %	5 %	5 %	5 %	5 1/16 — 5 3/16	5 1/16 — 5 3/16	..	..	..

Shares not officially quoted :—Mackay Companies, ord., 61—62. Pref. 75—76.
† Unless otherwise stated all shares are fully paid. § Interim dividends.

Bank rate of discount 4 per cent. (September 28th. 1905).

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING FEBRUARY, 1906.

On the occasion of our last reference to the above, attention was drawn to the high value attained by the imports during the month of January. The figure then mentioned is, however, far exceeded by the February returns, as shown below.

For the latter month the totals were:—Exports, £116,471; imports, £170,109; and re-exports, £12,703—which compare with £114,509, £155,095* and £8,747 respectively in January.

Thus the export business shows but slight improvement, the increase over the previous month amounting to £2,000 in value. Increases are apparent in our exports of cables and electrically-driven machinery, counterbalanced, however, by a drop in value of electrical machinery exports. One small item of tramway material figures in the export section.

Both the import and re-export sections of the table, however, show proportionately large increases in value, the totals being the highest recorded during the 13 months in which these returns have appeared.

With regard to the former section, the values of electrical machinery (£63,000) and of telegraph and telephone material (£30,689) imported, are largely ahead of the previous month's figures; it will be noted that the imports classified as electrical goods and appliances continue to fall in value, the decrease during the month amounting to some £9,000. The prominent purchasing and importing countries remain substantially as in our last returns.

* During the month, deductions amounting to £2,274 in value have been made from the January imports, thus reducing the total to the amount here given, viz., £155,095.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Country receiving exports and importing.	Electrical goods and appliances.	Electrical cable.	Electric lighting fittings and accessories.	Electric lamps.	Electric meters and instruments.	Electric machinery.	Batteries and accumulators.	Carbons.	Telegraph and telephone material and electric bells.	Electrically-driven machinery.	Tramways apparatus and materials.
	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark	310	1,182	14	170	...	5,055	64	...	...	910	...
Germany	137	...	105	18	90	102	6	...	141	566	...
Netherlands	219	483	385	...	...	37	...	5	...	...	...
Dutch Borneo and Indian Possessions	111	...	...	...	...	90	...	...	...	13	...
Belgium	139	24	170	23	12	38	13	...	229	22	...
France	154	480	54	11	2	314	...	...	11	...	...
French Indo-China	9	...	...	...	...	...	...	...	...	7	...
Portugal, Portuguese East Africa and India ...	129	155	221	...	567	110	...	...	115	...	...
Spain and Canary Isles	5	4	3	...	...	145	...	...	125	824	...
Italy and Austria-Hungary	60	...	32	...	800	428	...	...	...	...	...
Turkey, Greece and Persia	45	...	...	...	...	...	...	...	4	...	...
Egypt	178	5	24	11	90	17	...	...	...	24	...
China and Siam	269	217	607	76	172	445	95	...	95	58	...
Japan	177	6,742	72	...	811	1,210	...	14	...	...	...
U.S.A., Philippines and Cuba	591	...	10	90	20	708	...	...	...	4,298	...
Mexico, Panama, Columbia and Peru	48	107	...	18	146	36	...	5	...	...	...
Chili	33	...	396	...	...	5,131	...	...	2	...	...
Brazil	72	...	66	10	12	1,097	...	...	...	...	...
Argentine	5,817	3,442	102	582	74	2,638	451	...	119	4,027	...
Channel Isles and Malta	69	1,828	1,619	138	38	120	5	...	61	...	...
British West Africa	...	4	132	...	9	...	15	...	90	...	...
Cape of Good Hope	1,435	376	744	703	186	1,487	131	...	21	...	...
Natal	691	1,540	1,888	717	198	1,766	95	...	...	90	...
British East Africa and Aden	...	3	...	...	...	...	...	...	29	81	...
India	3,409	3,236	2,071	651	458	6,304	343	36	46	3,830	1,604
Burmah	8	1,680	98	18	...	...	25	...	...	17	...
Ceylon	48	42	94	...	4	8	21	...	19	...	...
Straits Settlements, Sarawak and Labuan ...	263	58	51	60	25	28	...	22	90	...	...
Hong Kong	32	...	64	55	...	...	75	...	...	1,531	...
West and South Australia	63	401	115	9	344	2,045	...	...	...	...	...
Victoria	230	637	12	6	...	116	...	48	59	...	...
New South Wales and Queensland	1,254	1,809	125	423	130	1,188	50	60	102	265	...
Tasmania	20	...	...	...	11	...	...	...	...	...	...
New Zealand	613	4,968	273	56	392	120	84	...	...	30	...
Canada	70	...	172	22	...	...	...	...	...	...	...
British West Indies and British Guiana	115	6	2	...	...	...	...	...	32	4	...
Total, £	16,823	29,429	9,721	3,870	4,591	30,783	1,473	190	1,390	16,597	1,604

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

	£	£	£	£	£	£	£	£	£	£	
Russia, Norway, Sweden and Denmark ...	90	185	...	146	4	1,409	508	23	14,677	...	...
Germany	4,424	5,989	937	463	95	30,944	145	1,192	1,433	...	...
Holland	1,493	3,945	50	6,048	85	875	888	7,404	416	...	...
Belgium	1,879	2,451	251	3,056	...	2,726	293	1,015	14,076	...	...
France	3,413	9,997	337	708	1,330	1,390	1,238	2,332	...	...	...
United States	2,075	8,894	851	362	9	24,693	154	20	77	887	...
Canada	...	...	...	613	...	870	...	...	10	...	...
Total, £	13,374	31,461	2,426	11,396	1,523	62,907	3,226	11,986	30,689	887	...

Additional Imports: New South Wales, electrical machinery, £70; Victoria, cable, £90; and Italy, cable, £74.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

	£	£	£	£	£	£	£	£	£	£	£
Various countries, mainly as above	1,282	2,642	339	278	...	5,520	529	716	1,370	27	...

Total Exports:	Total Re-Exports:	Total Imports:
£116,471	£12,703	£170,109

Note.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

SOME NOTES ON WIRES.

By THOMAS CARTER, A.M.I.E.E.

The following notes were compiled for the purpose, mainly, of comparing different wires available for resistances of various types, and were found to be very useful at the time, as no collected data of the kind had been noticed. While there are now to be found in Whittaker's "Electrical Engineer's Pocket-Book" some notes of a similar character to these, under the heading of "Heavy Current Resistances," there are, in what follows, some points of additional interest not mentioned in that excellent *vade mecum*, and they may, therefore, be useful in saving time in calculation.

In any wire of resistance R ohms, diameter d inches, length l inches, carrying a current of C amperes, the heat produced per unit of surface per second is proportional to $\frac{C^2 R}{\pi d l}$. Hence, if there are two wires, in each of which the heat produced per unit of surface per second is the same,

$$\frac{C^2 R}{\pi d l} = \frac{C_1^2 R_1}{\pi d_1 l_1},$$

where C_1, R_1, d_1, l_1, are for the second wire what C, R, d, l, are for the first.

Also if ρ be the resistance of a piece of the wire 1 in. long by 1 sq. in. in section, then—

$$R = \rho \frac{l}{\frac{\pi}{4} d^2},$$

and hence $$\frac{C^2 R}{\pi d l} = \frac{C^2 \rho l}{\frac{\pi^2}{4} d^3 l} = \frac{C^2 \rho}{\frac{\pi^2}{4} d^3}.$$

Therefore, in the two wires considered, the heat generated per unit of surface per second is equal if—

$$\frac{C^2 \rho}{d^3} = \frac{C_1^2 \rho_1}{d_1^3} \text{ since } \frac{\pi^2}{4} \text{ is constant.}$$

Considering now the radiation of heat from the wire as opposed to the generation of heat in it, let h be the number of pound-degree-Fahrenheit heat units emitted from 1 sq. in. surface of wire per second per degree rise in temperature of the wire above its surroundings. Then if τ be the rise in temperature at any given moment, the heat radiated is obviously

$h \tau$ lb. deg. F. units per second from each square inch.

When a steady temperature is attained, the heat generated is equal to the heat radiated per unit of time. The heat generated per second, per square inch of surface, is, from the above,

$$\frac{C^2 R}{\pi d l} \text{ joules per second,}$$

and, since one lb. deg. F. heat unit is equivalent to $1{\cdot}06 \times 10^3$ joules, for a steady temperature,

$$\frac{C^2 R}{\pi d l} = 1{\cdot}06 \times 10^3 \times h \tau.$$

It may be fairly safely assumed that h is a constant for all kinds of wire, and, therefore, for a given temperature rise, the heat generated per unit of surface per second should be the same in every case. As this is the correct basis of comparison for resistances, the necessity for starting from a basis of equal heat generation per square inch is obvious.

It has already been seen that $\frac{C^2 R}{\pi d l}$ will reduce to $\frac{C^2 \rho}{\frac{\pi^2}{4} d^3}$, and therefore for a steady temperature

$$\frac{\frac{C^2 \rho}{\pi^2}}{\frac{4}{4} d^3} = 1{\cdot}06 \times 10^3 \times h \tau,$$

or $$\frac{C^2 \rho}{d^3} = \frac{\pi^2}{4} \times 1{\cdot}06 \times 10^3 \times h \tau$$

$$= 2{,}614\, h \tau.$$

The value of h may be put down at about 6×10^{-6}, although this is only a rough figure, applying to wires wound up in coils, and varying with the amount the coils are stretched. It shows, however, of what order of magnitude the quantity is. If the actual temperature of the wire be limited to 250° F., a rise of, say, 190° above ordinary atmospheric temperature, the relation becomes

$$\frac{C^2 \rho}{d^3} = 2{,}614 \times \frac{6}{10^6} \times 190 = \text{very nearly } 3,$$

so that $C^2 = 3 \frac{d^3}{\rho}$ for a final rise of under 200°,

and generally, though roughly, $C^2 = {\cdot}015 \frac{d^3}{\rho} \tau$ for a final rise of τ°. Several results are at once apparent from this. For instance, in wires of the same material, ρ being constant, C^2 is proportional to d^3, or the current which gives a certain temperature rise is proportional to $d^{\frac{3}{2}}$. This is a well known fact, and is one of the most frequently used relations in working out resistances.

Again, in two wires of different materials, if the current be the same in each, then for the same rise in temperature d^3 must be proportional to ρ or d is proportional to $\rho^{\frac{1}{3}}$. If, on the other hand, the diameters are the same, the current, for a given temperature rise, is proportional to $\rho^{-\frac{1}{2}}$ since $C^2 \rho$ is constant.

Going now in a slightly different direction, and remembering that for a constant resistance $\frac{\rho l}{d^2}$ must be constant, it is evident that in two wires of the same material and of the same resistance, $\frac{l}{d^2}$ is constant, or l is proportional to d^2. Again, if two wires of different materials have to be of the same resistance and carry the same current with the same temperature rise, besides having d proportional to $\rho^{\frac{1}{3}}$, as shown above, $\frac{\rho l}{d^2}$ is constant since the resistances are the same, *i.e.*, $\frac{\rho l}{\rho^{\frac{2}{3}}}$ or $\rho^{\frac{1}{3}} l$ is constant, so that l is proportional to $\rho^{-\frac{1}{3}}$. Further, since d is proportional to $\rho^{\frac{1}{3}}$ and l to $\rho^{-\frac{1}{3}}$, d is evidently proportional to $\frac{1}{l}$, or $d l$ is constant in two wires of the same resistance and of the same carrying capacity.

Still further, if resistance and current capacity are to be constant, since d is proportional to $\rho^{\frac{1}{3}}$ and l to $\rho^{-\frac{1}{3}}$, and further, since volume is proportional to $d^2 l$, it is evident that the volume is proportional to $\rho^{\frac{2}{3}} \times \rho^{-\frac{1}{3}}$ or to $\rho^{\frac{1}{3}}$, and since weight is proportional to volume and to specific gravity (S), it is found that for two equal resistances each of the same current-carrying capacity the weight is proportional to $\rho^{\frac{1}{3}}$ S. It is evident therefore that to get as light a resistance as possible, a material should be used which is as good a conductor as possible and of as low a specific gravity as possible. In cases, however, where the temperature coefficient is to be small a high-resistance material must be used, as all the known good conductors have a high temperature coefficient. If ϕ be the cost in pence per pound of the material, then the total cost of the resistance is proportional to ϕ and to the weight, or cost of resistance varies as $\phi \rho^{\frac{1}{3}}$ S, neglecting, of course, the frame, and considering only the wire. It will be seen from the subsequent table that iron is by far the cheapest material to use, and it is extensively employed for starting resistances where temperature coefficient does not matter. Eureka and Constantan wires seem to be generally used for shunt regulating resistances and the like, as their specific resistance is practically independent of temperature. They cost finally about 30 times as much as iron wire. If a particularly light resistance were ever required, and cost and high temperature coefficient were not to be considered, then evidently aluminium would be very suitable, as the wire would weigh only about 20 per cent. of a corresponding iron wire resistance, though the cost would be about seven times as great for wire alone.

Taking up another point—namely, the relations between resistance, length, and weight in any wire—the pounds weight per cubic foot = 62·35 S, where 62·35 is the weight

in pounds of a cubic foot of water. Further, the cubic feet per ohm = (length per ohm in feet × sectional area in feet),

$$\text{or cubic feet per ohm} = \frac{\frac{\pi}{4} d^2}{12\rho} \times \frac{\frac{\pi}{4} d^2}{144},$$

hence pounds per ohm = pounds per cubic foot × cubic feet per ohm = $62{\cdot}35 \times s \times \frac{\pi^2}{16} \times d^4 \div (1{,}728\,\rho)$

$$= {\cdot}0222 \frac{s}{\rho} d^4.$$

Hence also, taking the reciprocal, ohms per pound

$$= 45 \frac{\rho}{s} d^{-4}.$$

$$\text{Again, feet per pound} = \frac{\text{cubic feet per pound}}{\frac{\pi}{4}\left(\frac{d}{12}\right)^2}$$

$$= \frac{1}{62{\cdot}35\,s} \times \frac{4 \times 144}{\pi d^2} = 2{\cdot}94 \times \frac{1}{s d^2},$$

and, taking reciprocals, pounds per foot = $\cdot 34\, s d^2$.

Again, from the last four results, ohms per foot = ohms per pound × pounds per foot

$$= 45 \frac{\rho}{s} d^{-4} \times {\cdot}34\, s d^2$$

$$= 15{\cdot}3 \times \rho d^{-2}$$

$$\text{and feet per ohm} = {\cdot}065\, \rho^{-1} d^2.$$

Remembering that $c^2 = 3 \frac{d^3}{\rho}$ for about 200° final rise, this can be transformed to

$$c = d^2 \sqrt{\frac{3}{\rho}},$$

and this factor $\sqrt{\frac{3}{\rho}}$ can be determined for each sort of wire, and is a figure of merit for the material as regards its current carrying capacity.

The following table may be useful, embodying, as it does, several of the results of the foregoing general conclusions:—

Material.	ρ Actual. At 60° F.	ρ Actual. After 200° rise.	ρ Relative. At 60°.	ρ Relative. After 200° rise.	$\sqrt{\frac{3}{\rho}}$ For 200° rise.	s Actual.	s Relative.	Relative weight for same C and R 200° rise.	Approx. cost ϕ.	Relative total cost for same C and R 200° rise.	Relative length for same C and R 200° rise.	Relative diameter for same C and R 200° rise.	Constant for pounds per ohm at 60°.	Constant for ohms per pound at 60°.	Constant for feet per ohm at 60°.	Constant for ohms per foot at 60°.
Copper ...	·00000066	·00000090	1	1·4	1,830	8·9	1	1	8	4·9	1	1	300,000	·0000033	100,000	·000010
Aluminium ...	·00000119	·0000017	1·8	2·6	1,330	2·6	·297	·36	32	7·1	·81	1·23	49,300	·0000203	55,000	·000018
Iron wire ...	about ·0000043	·000006	6·5	9	710	7·8	·876	1·63	1	1	·54	1·86	40,000	·000025	15,000	·000066
Platinoid ...	·00001613	·0000165	24·5	25	420	8·9	1	2·61	33	53	·38	2·62	12,260	·0000816	4,050	·000247
Manganin ...	·00001646	·0000165	25	25	420	8·9	1	2·61	44	71	·38	2·62	12,000	·0000833	3,960	·000252
Eureka ...	·00001980	·0000198	30	30	390	8·9	1	2·78	28	48	·36	2·78	10,000	·000100	3,300	·000303
Resista ...	·00003022	·0000334	46	50	300	8·2	·92	3·03	—	—	·30	3·33	6,000	·000167	2,170	·000462
Krupp... ...	·00003340	·0000358	50	54	290	8·1	·91	3·07	32	60	·296	3·38	5,390	·000186	1,960	·000510
Wolffin ...	·00003340	·0000358	50	54	290	8·2	·92	3·10	20	38	·296	3·38	5,440	·000184	1,960	·000510
Beacon ...	·00003375	·0000358	51	54	290	8·1	·91	3·07	25	47	·296	3·38	5,320	·000188	1,940	·000515

The values given are, in many cases, only approximate, but are sufficiently close to give a comparison between the various materials. The most uncertain figures are, probably, the values of ρ at the high temperature. This causes some doubt as to the value of $\sqrt{\frac{3}{\rho}}$. The cost of wire per pound is also only very roughly correct, and it must be remembered that ϕ increases for a given material with decrease of diameter, so that the results of total cost for same C and R are qualitative, rather than accurately quantitative. The columns "relative length" and "relative diameter" for same C and R give, of course, relative values of $\rho^{-\frac{1}{2}}$ and $\rho^{\frac{1}{2}}$ respectively. The meanings of the "constants" in the last four columns are, respectively, $\cdot 0222\, s\rho^{-1}$, $45\, s^{-1}\rho$, $\cdot 065\, \rho^{-1}$, and $15{\cdot}3\,\rho$. That is to say, in order to get the actual pounds per ohm, &c., the constants given have merely to be multiplied by d^4, d^{-4}, d^2 and d^{-2}, respectively.

The foregoing particulars will, it is hoped, be of use to many who have not had an opportunity of collecting them systematically; and, in conclusion, further mention may be made of Whittaker's Pocket-Book, to which reference may be made for a few additional matters not treated of in this article.

THE ADAPTABILITY OF VARIABLE SPEED MOTORS.

[COMMUNICATED.]

When one considers the ease with which an electric motor can be designed to be suitable for the special work it has to do, it is surprising how little advantage is taken of this flexibility in practice. Almost all specifications bear the most striking similarity to one another for widely different applications, except in a few minor details of construction, which may be done just as well in several different ways. Otherwise the usual specification is as follows:—

1. The armature core to be built up of soft re-annealed high permeability sheet steel. (No mention is made of the non-ageing qualities, which are more likely to be useful, from a purchaser's point of view.)
2. The efficiency at full load, three-quarter, half and quarter load to be guaranteed.
3. Not less than 98 per cent. conductivity copper (Mathiessen's standard) to be used.
4. Current density in the armature conductors is not to exceed 1,500 amperes per sq. in.
5. Maximum current density in the brushes not to exceed 30 amperes per sq. in.
6. Commutation to be absolutely sparkless, from no load to 25 per cent. overload with fixed brushes.
7. After six hours' run at full load, no part to exceed 70° F. rise in temperature.
8. Magnet poles to be laminated.

Taken individually these points are important and excellent, but taken collectively in one specification they are needless repetition. If efficiency is guaranteed, why specify the conductivity of the copper, or that the core is to be laminated? If the motor is to be absolutely sparkless, the temperature rise fixed, and efficiency guaranteed, why specify the current density in the brushes regardless of what quality of carbon may be used? Then why specify laminated poles; the customer actually loses by this, because it enables the manufacturer to cut down the length of the air gap. This point is already covered by the guaranteed efficiency and maximum temperature rise.

It is now becoming usual to specify for what purpose the motor is required, but in actual practice, what is gained? The conscientious manufacturer who quotes for the most suitable design for the work it will have to do, will be out of it on price, and the order goes to the manufacturer who

quotes for his nearest standard motor, which will satisfy the test conditions and with the wonderful adaptability of the electrical machine, will manage to do the work required. The "strong" armature, "light" magnetic flux type of motor, or the even worse interpole motor, when advantage is taken of the corrected "field" distortion or forced commutation to put in a still stronger armature, while eminently suitable for steady loads and easy conditions, is hopelessly bad for workshop and factory use when there is frequent starting of heavy machine tools and heavy overloads.

Take the old type belt or gear-driven planing machine, how often does the power taken for cutting or quick return stroke, fix the horse-power of the motor to drive it? In nearly every case it will be found that the sparking at the commutator at reversal fixes the size, especially on higher voltage circuits. Hence one sees a motor rated to give, say, 40 or 50 B.H.P. continuously working on an average load of about 10 B.H.P. In many cases a fly-wheel has to be fitted, which would be quite unnecessary with a suitably-designed motor.

The same design of motor will be seen driving pumps, where it is required to frequently start up against a "dead" load, bending rolls, rolling mills, haulage gear, coal cutters, &c., with the inevitable waste of energy, heating of the starting resistances, and flashing at the commutator and switch contacts.

Where automatic starting switches are used, and as usual give trouble, the switch is blamed when the fault really lies with the design of the motor. The writer has had experience of automatic starting switches of the very simplest description, starting up 20 and 30-H.P. motors against heavy loads, hundreds of thousands of times, without a single failure or renewal. There is only one design of motor which is thoroughly suitable for this class of work, and that is the plain variable speed motor, even in the few cases where speed variation is of no special value. This design of motor with its strong magnetic "field," exceptionally good commutation, and high specific torque, with the full excitation corresponding to its slower speeds, gives the ideal machine for this heavy duty.

If a 3 to 1 speed range motor is run at its middle speed, the maximum *continuous* output is approximately 50 per cent. greater than the rated horse power of the motor, so that the apparent extra cost over that of the ordinary design is not what it seems at first. While to take advantage of the more or less intermittent nature of this class of work, by compounding or otherwise strengthening the magnetic field of the motor, to correspond to its slowest speeds, it will give two to three times its rated horse-power for short periods. With a given heavy current corresponding to an overload, the variable speed motor gives a correspondingly increased torque, but the usual design of motor, owing to its relatively strong armature, distorting or practically wiping out the "light" magnetic field, gives only very little more than its normal full load torque.

That this point has been more or less recognised for many years is proved by the universal practice of using series or compound wound motors,* but in no case can the writer remember it being specified that this important characteristic should be increased by putting extra material in the magnetic circuit and so allowing a *considerable* increase in "field" strength.* This condition the variable speed motor run normally about its middle speed, exactly meets in the best and most economical way.

Other incidental advantages are :—

1. The reduction in the number of types and sizes of motors, with the consequent reduction in the number of spares.

2. The adaptability to existing pulleys, gears, &c. This point is especially important for emergency work.

3. If an armature is wound to run at what corresponds to the middle speed, of say, a 3 to 1 range variable speed motor, with the full field corresponding to the usual slow speed, it will give double the rated horse-power of the variable speed armature continuously, and four times as much, intermittently, at a cost very slightly greater than that of the ordinary motor designed for this speed, this armature being *mechanically* interchangeable with the variable speed one.

There are many ways in which the specification can be worded to ensure this charactertistic, the simplest perhaps being that the speed should be reduced a certain amount *with a given increased excitation*.

* Since writing the above the writer has seen Mr. R. W. Birkett's article in the *Engineer*, which describes a step in the right direction, but does not go far enough.

SOME NOTES ON GAS ENGINES FOR ELECTRIC LIGHTING.

By R. C. DIEPPE, A.M.I.E.E.

Many electrical engineers probably have at some time or another te handle gas engines for driving dynamos for isolated electric light installations, and having recently had some experience with these engines for this purpose, I think that the few tips which have been gained may be of considerable use to other electrical engineers, who, like myself, may not be experts in the design, &c., of gas engines, but still may have to order them and put them into use. In my opinion there is no doubt whatsoever that electricity can be very cheaply generated with small isolated plants, by means of gas engines, and in the case of a large shop, &c., where the annual bill for electricity is from £150 to £200 or over, and where there is already a man on the staff of a somewhat mechanical turn of mind, electricity can be generated at something under 2d. per unit with gas at 2s. per 1,000 cb. ft., and allowing for interest on capital, depreciation, &c. Of course, no definite figure can be given to apply to every case, as it depends on the number of hours per evening the electricity is required, and the nature of the load. However, with regard to the latter, in the case of shop lighting it is nearly constant at full load the whole time.

When asking for quotations for a gas engine for the above purposes, it is advisable to ask each firm to state the following particulars regarding the engine they propose supplying : (1) The maximum brake-horse-power of the engine for one hour ; (2) the continuous working brake-horse-power of the engine ; (3) the speed of the engine in revolutions per minute ; (4) the piston speed ; (5) the maximum variation in volts in, say, 15 minutes when running on half, three-quarter and full load, the load in each case being kept constant during the 15 minutes ; (6) the maximum variation in volts when the load is suddenly changed from half-load to full load, or *vice versâ* ; (7) the maximum initial pressure upon explosion when running on maximum load and on continuous working load ; (8) the consumption of gas at half, three-quarter and full load.

When comparing the various makers' quotations, the ratio of (1) to (2) should be carefully noted, as with gas engines, unlike electric motors, the maximum B.H.P. is a definite quantity, and one cannot squeeze a little more out of the engine at a slight increase of temperature rise. A gas engine will give so much and no more, and it is advisable, for the sake of cost of repairs and maintenance, to have the above ratio as high as possible. For instance, a gas engine to give 25 B.H.P. continuously should give 30 B.H.P. as a maximum for one hour. Items Nos. 3 and 4 can be considered together. The actual speed of the engine is not of much importance, electrical engineers being used to much higher speeds than are possible with gas engines. The piston speed is the chief point to watch, and this for a 25-B.H.P. high-speed electric lighting engine for direct coupling should not exceed 750 to 800 ft. per minute. This figure will be somewhat of a guide, and anything above 800 ft. per minute for an engine of this size should be questioned. The variation of voltage is an important item. Gas engine makers will not, if they can help it, give any figures on this point, satisfying themselves by saying that there shall be no fluctuation in the light. Now, this is very vague and may lead to a lot of trouble, and it is advisable, if possible, to insist that the maximum variation in volts be stated not only at full load, but at half load. At the various exhibitions one sees gas engines driving dynamos which are lighting the lamps on the stall, and only the very slightest fluctuation in

the light can be observed ; but a user will possibly find that when the same set is removed to his premises the light is not quite so steady. The load on the engine at the Exhibition has been adjusted to the best possible advantage for steady running, which is at or near full load, whereas, of course, the engine will not always be run on full load in practice. In connection with this point, it will be noted that gas engine makers should raise no objection to giving a figure for the variation in volts during, say, 15 minutes at a constant load, as, no matter what kind of dynamo is used, whether compound-wound or shunt-wound, the variation in volts will be directly proportional to the variation in the speed of the engine. In checking the makers' figures, it will be generally quite near enough to read the maximum and minimum volts that can be observed on a fairly open-range voltmeter ; but, of course, if greater accuracy is required, a recording voltmeter can be used. The variation should not exceed 1½ per cent. to 2 per cent. at full load. and 2 per cent. to 3 per cent. at half load.

The maximum initial pressure upon explosion is an important point, as upon this depends the silent running of the engine, as well as the ease with which it is started, and the cost of repairs and maintenance. If this initial pressure is too high, there will be an objectionable bump on the engine when running at full load, and a special point should be made when ordering the engine that it should be free from this bump. Owing to the keen competition between the various makers the initial pressures and piston speeds are being raised to their limits, and in some cases beyond, but the bump caused by the former being too high is most objectionable inside a building. This bump is not to be confused with the noise made by the exhaust, which latter can be silenced to a great extent.

The consumption of gas is another important point, and it is most important to get the makers to state the consumption not only at full load (which they will be most pleased to do), but also at half and three-quarter load.

In addition to the above and before ordering the engine, it is advisable, if the engine is going inside a building, to let a representative of the engine makers from whom the engine is to be ordered see the site and approve of same. This may save future trouble.

The actual wording of the order is most important, and it should be given very careful consideration. The first points are, of course, the output and speed. The next is the question of the consumption of gas at the various loads, and in connection with this it is most important to state the source of the supply of gas. This should be stated when inquiring for the engine, but under no circumstances should a gas engine be ordered unless the outputs and consumptions are guaranteed when the engine is supplied with gas from such and such a company. It will be unnecessary, and even not advisable for the purchaser to go into the question of calorific values. This should be left entirely to the gas engine makers, who know all about it and whose duty it is to know all about it. I have been told by a very good authority that the gas in certain districts where gas engine makers do most congregate, is rich in hydro-carbons, but possibly this is on a par with the very dry steam sometimes met with when testing steam engines at the maker's works. There are tricks in every trade, by no means excepting the gas engine trade. The figures guaranteed in connection with the other items enumerated above should then, of course, be stated, and it should also be stated that the engine must be free from noise or vibration when running at its full continuous working load, and that it must be easy to start up. Regarding the vibration, it should be stated that the engine makers are to supply all drawings of foundations which will be carried out entirely to their instructions under which circumstances they are to guarantee that there shall be no cause for complaint regarding vibration. If the engine is going in a separate building, the question of noise and vibration will not be of so much consequence, but if the engine is going in the basement of a building, it is advisable to isolate the foundations all round, and to keep them well away from the footings of the walls. If these conditions are carried out, and the engine does not "bump" generally, there will be no perceptible vibration ; but the subsoil wants carefully inspecting, and if this is rock or very hard clay, the foundations should be placed on a few inches of felt. If the noise of the exhaust is likely to be a nuisance, it can be silenced to a considerable extent by means of a silencing chamber consisting in some cases of a deep pit lined with fire brick. Should the engine be placed in a basement, it is possible that water may be reached before getting to the required depth for this pit, and as the pit must be watertight some difficulty then arises. There are two ways out of the difficulty, one being to sink a stout cast-iron tank in the ground, and the other to dig a pit deeper and larger than is required for the ordinary and firebrick walls, and to line it with hydraulic cement, the ordinary and firebrick walls being put on the inside of the cement. This work should be most carefully carried out as if the pit is not watertight it will lead to considerable trouble and expense at a future date. It must be borne in mind that the silencing chamber gets very hot so that only certain materials can be used.

The chief test should always take place on site, and with the actual conditions under which the engine is required to work ; and although a preliminary test might be witnessed at the makers' works, this should only be treated as preliminary, as the difference in the quality of the gas at the two places, may make a considerable difference to the running of the engine.

The engine makers should be told the name of the dynamo makers, and should also be asked to agree to an electrical load being used for testing the engine, allowance being made for the efficiency of the dynamo. There is an important point here, and it may be difficult to get the engine maker to agree to this, although there should be no objection. If the dynamo is ordered from a firm of repute, and they are asked to guarantee their efficiencies at the various loads, and to verify them when testing the dynamo, then with these figures it is a very simple matter to test the whole installation at any load. In any case, if the engine makers object to this method of testing the engine, the purchaser will be able to test the plant in this way, and should the results not be as guaranteed he will have very good grounds for going further into the matter and testing the engine by means of a brake or by indicating the engine at no load and full load. However, neither of these later methods are as simple, cheap or accurate as the electrical method with which the load can be accurately observed for any length of time and the output in units taken by means of a wattmeter.

In conclusion, it is not assumed that any of the above points are new to the gas engine expert, but if the electrical engineer, who is not a gas engine expert, will carefully bear them in mind when dealing with gas engines and gas-engine makers, he will be perfectly safe should the engine not come out on test as guaranteed.

THE NEUTRAL MARKETS OF THE WORLD THEIR OPPORTUNITIES.

III.—Chile.

The commercial relations of Chile have wonderfully improved in recent years, both as regards its trade and industry. Particularly was this improvement shown during the last six months of 1904 and the year 1905. For two years or more the exchange has been maintained at a relatively high and stable rate, and this, combined with the high prices which have prevailed in the copper and saltpetre markets, has been the chief cause of the improved conditions of the country.

The imports in 1904 amounted to 157,152,080 pesos (gold peso = 1s. 6d.), as compared with 142,470,579 pesos in 1903 and 132,428,204 pesos in 1902. Of the imports in 1904, 57,345,488 pesos were from the United Kingdom, 42,456,638 from Germany, and 13,997,927 from the United States, increases of about 4,000,000 pesos in the cases of Germany and the United Kingdom, and an increase of about 1,500,000 pesos in the case of the United States. Imports from Germany are, however, increasing in a greater ratio than those from the United Kingdom.

The exports from Chile in 1904, which consist to a great extent of saltpetre and copper, amounted to 215,997,784 pesos, as against 194,279,679 pesos in 1903, and 185,879,965 pesos in 1902. Of the exports in 1904, 70,546,667 pesos were to the United Kingdom, 62,632,942 pesos to Germany, and 30,715,150 pesos to the United States, increases of about 10,000,000 pesos in the cases of Germany and the United Kingdom, and a decrease of 2,000,000 pesos in the case of the United States.

It is difficult to arrive at any very satisfactory details as to the imports of particular classes of electrical goods, as these are so often included under other general headings; but the following particulars may probably be of some service in giving a general idea of the nature and extent of the trade. The imports of materials for railways, vessels and telegraphs in 1904 amounted to 2,327,000 pesos, of which 1,370,000 pesos were from the United Kingdom, and 497,269 pesos from Germany; the total imports increased by 800,000 pesos, whilst those from the United Kingdom increased by 460,000 pesos. The imports of bronze and copper in bars, &c. (includes copper wire), amounted to 361,000 pesos, or double the imports in 1903; imports from Germany increased from 46,625 pesos to 151,000 pesos, and exceeded those from the United Kingdom by 20,000 pesos. Lamps and lighting utensils of glass were imported to a value of 254,000 pesos, a slight decrease; of these, 181,000 pesos were from the United States. The imports of glass and porcelain (various), including certain insulators, amounted to 33,000 pesos, of which 25,000 pesos were from Germany. The imports of various kinds of apparatus, including insulators, telegraph material, &c., amounted to 147,000 pesos; the imports from the United Kingdom were 38,000 pesos, an increase of 2,000 pesos, and those from Germany 95,000 pesos, an increase of 25,000 pesos. Mining machinery, pumps, &c., were imported to the value of 3,228,603 pesos, or two and a half times the imports in 1903; the imports from the United Kingdom increased from 770,704 pesos to 1,929,832 pesos, and those from Germany from 394,253 pesos to 1,145,139 pesos. The imports of cranes, weighing machines, &c., amounted to 150,629 pesos, of which 106,401 pesos were from the United Kingdom. Machinery, &c., for industries, electric lighting, &c., motors, &c., were imported to the value of 7,436,000 pesos; the imports from the United Kingdom were 3,159,080 pesos, from Germany 798,000 pesos, and from the United States 2,780,000 pesos.

As compared with the figures for 1903, the imports of machinery, instruments, tools and apparatus of all kinds showed a marked advance; the imports in 1904 were valued at 20,890,000 pesos, as compared with 12,895,000 pesos in 1903. The figures of the imports of electrical goods, so far as they go, show that the United Kingdom in nearly all cases, holds the greatest share of the trade, but it is noticeable that imports from Germany in this line, as well as in the total trade, are increasing at a greater ratio than those from the United Kingdom, and that in Chile, as well as in the other South American countries, German capitalists are interesting themselves to a great extent in the undertakings of the country. Allowance must be made, however, in the use of the Chilian statistics, for the fact that in many cases the imports are not attributed in all cases to the real country of origin, but rather to the country from which they are *shipped*. As will naturally be seen, this method is more favourable for German figures than for those of the United Kingdom, so that it is possible that the figures for Germany are somewhat in excess of the real imports from that country. But in spite of this, it is evident that German manufacturers are succeeding to a great extent in the introduction of their goods on the Chilian market, and it behoves British makers to put forth strenuous efforts to retain the trade they already hold, and at the same time to gain their share of the increased trade which is sure to arise as the country develops.

There are at present in Chile about 25 towns which have taken up electricity for lighting purposes, the current being mostly supplied from steam-driven plants, and only in a few cases from water-power, which is not so abundant in most parts of the country as in other South American States. The electrical plant in Santiago, which uses coal as fuel, is employed for tramway supply as well as for public and private lighting purposes. The machinery was all imported from abroad, although the Sociedad Nacional de Electricidad, which manufactures dynamos and motors, has been in existence in Santiago for some time. The electric plant in Valparaiso, which is also run by steam power is, like the Santiago plant, used for tramway purposes as well as for lighting public and private buildings. It is proposed to utilise water-power as soon as the works near the town are finished. The capacity of these works will be 5,000 H.P. For the present only three turbines (Pelton water-wheel type) of 1,200 H.P. each are to be used. To each of these turbines is coupled a three-phase electric generator of 7,000 volts working pressure. By means of two separate sets of conductors, the current is brought to a point near Valparaiso, whence, by two sets of underground cables, it is delivered to the sub-station in the centre of the town. With these works the company will also be able to supply power for industrial purposes. A 500-H.P. steam plant is to be retained for reserve purposes.

As in Brazil and other South American States, so also in Chile, acetylene is becoming a keen competitor of electricity for lighting purposes, and a decree was recently put in force by the Government allowing the free importation of calcium carbide for the production of acetylene gas. Alcohol is also being used to some extent both for lighting and power purposes, and its further use is being encouraged. Gas is used, however, for lighting purposes in most towns, and the companies succeed in paying good dividends, particularly in Valparaiso and Santiago.

Of the electrical companies established in Chile, the following may be mentioned: the Cia Luz Electrica de la Serena, with continuous current from two Schuckert turbine sets; the Chilian Electric Tramway, Light and Power Co., with current supplied from five Allgemeine Elektrizitats Gesellschaft-Tosi turbine sets; and the Cia Gas de Valparaiso, with two Mavor and Coulson and McLellan turbine sets.

It is anticipated that the production of iron by electrical methods in Chile is destined to achieve great importance in coming years, particularly as the Government is doing all in its power to foster an iron industry in the country. The districts of the Cordilleras between 43° and 29° S. latitude are richly supplied with water-power, with strong falls in the immediate neighbourhood of iron ore and other metal fields. The following rivers are to be found near the iron ore fields, in Central Chile: the Marpo, Mapocho and Aconcagua; in Coquimbo: the Illapel, Choapa, Limari and Coquimbo; and in Atacama: the Huasco. The Sociedad de Altos Hornos Electricos was founded in Chile some little time ago by an Italian, Jose Pedro Alessendri, who proposed to manufacture iron and copper by means of electricity produced by water-power from the Rivers Tino and Tinquiririca. Recent advices from France state that a company is being formed in that country by the amalgamation of the Société Metallurgie Electrothermique and the Société des Hauts Fourneaux Electriques (apparently the Chilian company mentioned above) for the purpose of undertaking the production of metals by electricity. The title of the new company is to be the Cie de Metallurgie Electrothermique au Chile, and the capital has been supplied by the Maison Mirabaud.

Amongst public works which are to be undertaken, or have already been commenced in Chile, the following may be mentioned as showing the general development of the country:—The continuation of the Tacna-Arica Railway to La Puz, thus establishing direct communication between the Coast of Chile and the capital of Bolivia; the Transandine Railway, establishing communication overland with Buenos Ayres; the construction of a network of railways running from north to south of Chile; the construction of extensive port works in Valparaiso; the drainage of Santiago; &c.

The following duties are leviable on electrical goods in Chili: pushes for electric bells, 25 per cent. ad valorem, valuation 6·50 pesos per kilog.; bronze or copper wire and wire for electrical purposes, free; Morse's telegraphic apparatus, free; motors of all kinds, 25 per cent. ad valorem, valuation according to appraisement; special apparatus and accessories for electric lighting, except lamps of all kinds, but including bulbs and candles, free; insulators for telegraphs, telephones or electric lighting, and materials for telegraphs, free; goods not specially enumerated in the Chilian tariff and not being free of duty are liable to duty at the rate of 25 per cent. ad valorem. Valuations are fixed by the Customs authorities. All duties are levied in gold pesos of 1/6, and duties are payable in gold coin. Auctions are held weekly, at which gold received by the Government is re-sold to merchants who have to pay the duties. The present rate of exchange is 1/3½.

The following are firms interested in electrical undertakings who would be likely to import electric material direct:—

Santiago.—Chilian Electrical Co., Ltd.; C. Cordero, 1,547 calle Moneda; V. Gonzalez, 486 calle Mercedes; Harras & Cie., 3,066 calle Huerfanos; A. Hewstone, 3,067 calle Catedrale; R. Hewstone, 1,102 calle S. Rosas; L. Jaspard; R. Olivares, 1,345 calle Compania; R. Oliveira, 1,907 calle Catedrale; De Leon Ponce, 322 calle Mercedes; Rivano y Cia, 2,012 calle S. Francisco; Chile Telephone Co., 14 Galeria San Carlos; A. Goubet, 95 calle Catedrale; A. G. Hald, 56 calle Bulnes; G. H. Jones, 1,317 calle Casilla; Allen Kerr, 490 calle Cadella.

Valparaiso.—Chile Telephone Co.; Cia Alemana Transatlantica de Electricidad; Hormann y Cia; Rose Innes y Cia; Pacific and European Telegraph Co.; G. S. Lang, 906 calle Casilla; C. F. Heywood, 16 Casilla del Correo.

Tacna.—Cie Telephone et Telegraphe Tacna, Arica, &c.

Curico.—Soc. Anon. Electricité.

Iquique.—Central and S. American Telegraph Co.; West Coast of America Telegraph Co.

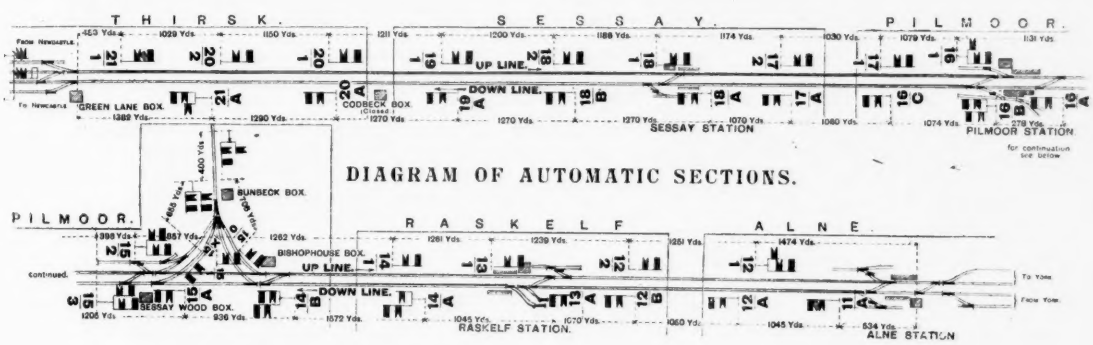
Perena.—Compania Luz Electrica.

The majority of business is done by European houses or merchants in Chile through their buying agents in Europe. Direct business, which is increasing and could be further increased by the employment of the right sort of travellers and care in the selection of customers, is usually done c.i.f. in European currency, to avoid the risk of exchange. The great requirement of the Chilian market is cheapness; but the finish and get-up should be made thoroughly attractive in order to create business. It is true in Chile, as elsewhere, that a German always make a common article look well. As an example of American methods of doing business in Chile, the following remarks made by Mr. Worthington, the Commissioner appointed by the Board of Trade to inquire into the conditions of trade in South America in 1898, may be quoted:—"The electric lighting of the nitrate works is leaving English makers because there is a very capable representative of the Westinghouse Co. in Iquique, who is always ready to negotiate for new installations, to supply small refits for American machinery, and, for a moderate monthly charge, to look after the electric plant continually, an arrangement which suits the companies well."

Commercial travellers are not required to obtain permits to exercise their calling in Chile, nor are any licences necessary. As regards samples brought by commercial travellers, the Customs are authorised to permit the dispatch for private warehouses of the samples with which the agents of commercial houses are travelling provided they are not complete sets of objects which would divest them of their character as samples. In virtue of this exemption, travelling salesmen may introduce their samples of foreign merchandise into any part of the Republic without paying in ready money the ordinary import duties, and have a term of six months in which to pay them if the samples which they bring are designed for consumption in the country. If they reship the samples to a foreign country, the I O U which they have signed for payment of the duties is cancelled without any charge.

AUTOMATIC ELECTRO-GAS BLOCK SIGNALLING ON THE NORTH-EASTERN RAILWAY.

In our issue for January 22nd, 1904, we made allusion to the forthcoming installation of the "Hall" electro-gas block signals on the 11 miles' stretch of the main line of the North-Eastern Railway between Alne (a few miles north of York) and the Green Lane signal box at Thirsk. After having been submitted to a protracted series of exhaustive trials, the plant—the first of its type to be introduced on any European railway—was formally introduced into regular daily operation some months ago, having been provisionally approved of by the Board of Trade. As previously remarked, the signals are the "Hall" electro-gas semaphores, and are arranged "normal danger" with a 1,200-ft. overlap. The second home signal in advance and its "distant" are cleared when an incoming train passes a "home" signal. In ordinary practice, this clearing point would be placed at the end of the overlap. In our previous article, we described the Hall signalling system, and from the accompanying diagram it will be seen exactly how the various signals comprised in the North-Eastern installation have been arranged. It may be pointed out that the signal box at Codbeck, formerly required with the mechanical system of block signalling, has been abandoned, whilst at other of the signal boxes, the attendance of the signalmen is restricted to the passing of trains from the branches leading to Gilling on the east, and Boroughbridge and Knaresbrough on the west. At Raskelf, Bishophouse and Sessay the automatic "home" and "starting" signals, with their "distants," are controlled by circuit-breaking springs on the signal levers in the cabin. For protection in foggy weather, the Raven fog-signal apparatus is connected with the automatic signals. This apparatus, devised by Mr. V. L. Raven, the assistant mechanical engineer of the North-Eastern Railway, strikes a projection on the locomotive and blows a whistle on the engine cab whenever a "home" signal in the "stop" position is passed. In addition to this precaution, which has been found to work very satisfactorily on other sections of the N.E. Railway, the ordinary arrangements for dealing with traffic in times of fog or falling snow are to be introduced. When a fog comes on in the neighbourhood of Alne, Pilmoor or Green Lane, the signalmen at those places must immediately communicate with each other by telephone, and one of them must call up the three station-masters, and have signalmen and platelayers called out for service, whilst signalmen must be provided for the cabins not ordinarily "manned," and platelayers must perform the ordinary fogging duties, placing detonators on the rails to repeat the signal movements. Until the signalmen at the intermediate boxes have reached their respective posts, the following time intervals will be observed in the passage of trains:—A passenger train following a goods train, 20 minutes; and a goods train following a passenger train, 10 minutes—no interval being prescribed for a passenger train following another passenger train, or for a freight train following another freight train. The same indication is used at night for both "home" and "distant" signals, namely, red for "danger," and green for "all clear." All the switches on this section of line are protected by mechanical interlocking, whilst the mechanical signals, so far as they have been retained, are controlled by the track circuit by means of the electric slot. Switch instruments are placed at each switch to shunt the track circuit, and, in the case of facing points, also to break the signal circuit. There are indicators and annunciators in the signal cabins to show the approach of a train and the presence of a train between the "home" and "starting" signals. It has been arranged that when a train has been detained by a home automatic signal for one minute, the enginemen may proceed with great caution, but if the "home" signal is at, or near, a signal box the signalman's written permission must be first obtained. To facilitate inquiries, all the cabins, the names and distances of which are given on the accompanying diagram, are connected by a telephone circuit, whilst at each of the stations there are telephones fixed in the station-masters' houses, and also in the dwellings of the foremen platelayers.



Automatic Signalling on the N.E.R.

MOTOR-'BUS v. ELECTRIC TRAMCAR.

[From a legal contributor.]

The fact that the Courts have recently declared that a railway company may not, in the exercise of its general powers, establish a system of motor-'buses is of interest from several points of view. A railway company is the creature of statute; its powers are limited by the statute by which it is empowered to carry on its undertaking. This being the law as declared in the case of railway companies, it is also the law in the case of tramways. Some years ago it was decided that the London County Council had no power to run horse-'buses in connection with their tramways; and there is no reason to think that, if the point were raised once more, the introduction of motor-traction would make any difference to the legal bearings of the case.

We may predicate, therefore, that no statutory company—*i.e.*, no company which is authorised by statute to carry out any particular undertaking, be it railway or tramway—can inaugurate a system of motor-'buses as part of its undertaking. It may also be said that no local authority can undertake the establishment of such a system without special Parliamentary powers.

In this state of the law, everything points to the motor-'bus forming the subject of discussion sooner or later before the Parliamentary Committees, when these bodies commence their labours during the course of the present session. Railway companies will seek the necessary powers; the local authorities which have already established a system of electric tramways may desire to have motors to act as feeders to their larger enterprise; while it is probable that some of these bodies, reluctant to embark upon an expensive tramway scheme, may be glad to obtain, for the benefit of their ratepayers, the services of a few motor-omnibuses. In all these circumstances it is probable that questions of importance will arise before the Committees as to the general policy which should guide the Legislature in granting or refusing power to put this twentieth century form of locomotion into practice.

The first important problem which requires solution is—Who will have the right to oppose a motor-'bus Bill? It is probably well known to readers of this Review that it is not given to everyone to indulge the expensive luxury of opposing a private Bill in committee. Some interest in the question under discussion, or, to use a Latin phrase in common use, a *locus standi* must be shown. The grounds upon which a *locus standi* may be granted are (1) competition *e.g.*, as where an omnibus company claim that a tramway (which forms the subject of a Bill) will interfere with them; or (2) interference with property, as where, for instance, the opponent asserts that a tramway running past his house will interfere with the comfort of his residence. Numerous other examples might be given. But it is not given to everyone who has an objection to give utterance to his views. Thus, a man who had an objection "on principle," or a mere æsthetic objection, to the establishment of an electric tramway which made use of overhead wires, would not be allowed to give evidence.

These questions are decided by what is known as the Court of Referees on Private Bills. They have laid down certain general principles which are of importance when we come to consider who are likely to be heard in opposition to a motor-'bus Bill.

The Standing Orders of the House of Commons give the Referees complete discretion as to the admission of petitioners to be heard on this ground. It was formerly the practice of this Court to decline to allow a railway company to oppose a horse tramway on this ground, but the adoption of electricity as a motive power effected a slight change in this respect. Thus in 1893 a railway was allowed a *locus standi* against the clauses and schedule of a Bill which authorised and regulated the use of electricity on certain tramways, inasmuch as they might directly or indirectly affect the railway; but it was given no general power to oppose on the ground of competition, since the Bill, which also included certain powers of purchase and amalgamation was held at most to improve existing competition. It may be taken, however, that according to existing practice a railway cannot oppose an electric tramway merely on the ground of competition. The reason for this is that the tramway taps a different source of traffic. One railway may

oppose another which is to run on a parallel route, just as a gas company may oppose an electric lighting scheme; but where the competition is not sufficiently close no *locus standi* is granted.

What opposition may be shown to a motor-'bus Bill? It is apprehended that the following may desire to oppose:—(1) Companies or local authorities whose tramways will be interfered with; (2) railway companies (including tube railways); (3) highway authorities; (4) frontagers, *i.e.*, persons owning property along the proposed route, who allege that their comfort will be interfered with. In trying to answer these questions, it must always be borne in mind that a private company may always establish a system of motor-'buses without any Parliamentary power. We shall now discuss the merits of each form of opposition in detail.

1. *Companies or Local Authorities whose Tramways will be interfered with.*—Suppose a railway company seeks Parliamentary powers to run motor-'buses, a neighbouring tramway authority may fear the stress of competition. When horse traction was the order of the day, competition was not formidable. It has been shown, however, that the motor-'bus can compete effectually with the electric tram. In these circumstances it is apprehended that the Court of Referees will concede a *locus standi* to those who are interested in an electric tramway system.

2. *Railway Companies (including Tube Railways).*—With regard to ordinary railways, it is very doubtful how far it would be in their interest or worth their while to oppose a motor-'bus Bill, inasmuch as the motor-'bus is essentially a door-to-door species of locomotion. Further, in view of the principles which appear to have guided the Court of Referees up to the present, it is open to to grave doubt whether a *locus standi* would be conceded. In the case of tube railways the case is rather different. They have no goods or mineral traffic. They are dependent for their revenue upon the carriage of passengers along a short route which can be traversed by a motor-'bus. Take a concrete instance. Suppose the County Council were to seek power to run motor-'buses from Baker Street to Waterloo. It is conceived that the new tube railway would have a deep interest in the scheme, and should be allowed to oppose. At the same time it is matter for speculation what weight would be given to the opposition, for the routes would not be altogether parallel, and many persons would use a 'bus who might be carried out of their way by the tube.

3. *Highway Authorities.*—Inasmuch as the local authority who would be entitled to promote a motor-'bus Bill is also the highway authority, the question of opposition from this source is not likely to arise with much frequency in practice. Nevertheless, it is apprehended that a highway authority would have an interest in opposing, inasmuch as a large number of heavy motors, albeit they are fitted with rubber tires, involve increased wear and tear to the highway.

4. *Frontagers.*—Seeing that the motor-'bus, and the noise and odours which it creates, have already come to stay, it is not likely that the Court of Referees would concede a *locus standi* to persons who desire to oppose upon the ground that they live along the proposed route.

Finally, with reference to all the above questions, there is a general observation which must inevitably weigh with the Legislature. It is competent for any private company or person to run a motor-'bus. Not so with a tramway. The laying of rails involves interference with the surface of the streets; and it also involves the grant of a "limited monopoly" to the company or local authority who obtain the provisional order. Further, a tramway company is subject to certain restrictions in the matter of fares, whereas a motor-'bus company may charge what it pleases. These are matters which in our view must necessarily weigh with Parliamentary committees, and will tend to induce them to give every facility for the establishment of the new form of locomotion.

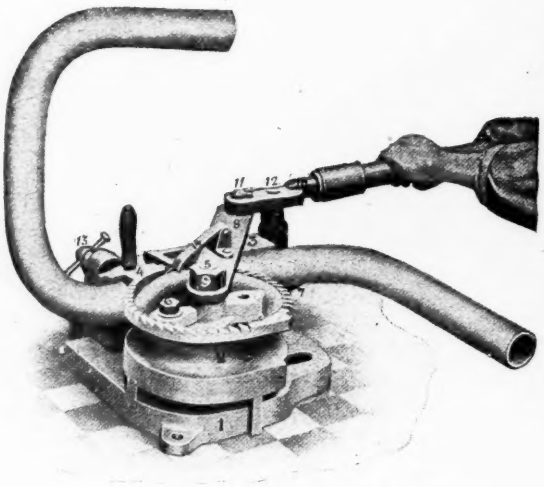
NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

The "Perfect" Pipe Bender.

Messrs. Edward Le Bas & Co., of Dock House, Billiter Street, E.C., are supplying the "Perfect" pipe bender, which is shown in the accompanying illustration. The machine, which is especially intended for electrical engineers, gas engineers, &c., is stated to bend perfectly by hand and without filling or heating, all sizes of tube up to 1 in. dia., and by heating the tube all sizes up to 3 in. dia., also without filling, the finished bends being free from puckers and of a perfect radius. The facility and ease with which bends can be produced at various angles in many instances makes screwed fittings unnecessary, and thus minimises the risk of leakage. The machine is very portable, and may be easily attached to any bench, or even held in an ordinary vice, and the rapidity with which bends can be produced by any workman renders it a great labour saver, so much so that the initial cost will be saved in a very short time.

The machine consists principally of the central pulley (2), bending block (3), clamping block (4), (each of which are provided with two grooves suitable for the outside diameters of the different sized tubes), the base plate (1), and the lever mechanism. The bender may be permanently attached to the bench, or may be held in the vice; the grooves in the central pulley (2), clamping block (4), and bending block (3), must be of the correct size for the tube to be bent. The central pulley (2) is placed on the centre bolt (5) in such a manner that the correct groove is with its flat side opposite the clamping block (4), and is then fixed in this position by the set screw (6); the bending block (3) is placed on the bolt of the lower lever (7) in such a manner that the longer end is towards the clamping block (4) and the correct groove towards the central pulley (2); the intermediate lever (8), which is provided with a ratchet, is then fitted upon the central bolt (5), and the nut (9) screwed on tightly; the main lever (10) then fits upon the pins (11 and 12), and is kept in position by the split pin; the lever mechanism is pushed back until the bending block (3) is in line with the clamping block (4).

The tube to be bent having been placed in position, the clamping block (4) is screwed up by means of the screw (13) until the tube is firmly held; the ratchet (14) is then dropped into the teeth provided on the rim of central pulley, and a uniform pressure is brought to bear upon the lever, which must not be jerked

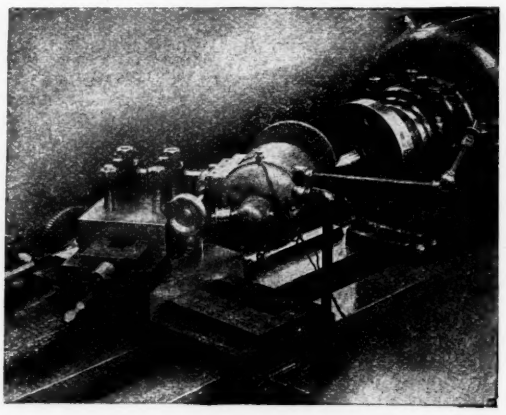


The "Perfect" Pipe Bender.

but slowly and steadily pulled forward. As soon as the main lever (10) forms an acute angle with the intermediate lever (8) the mechanism must be pushed back, the ratchet at the same time effects the advance of the bending block, which must be drawn towards the tube by means of the handle provided, and the bending is then continued in the same way until the desired angle is obtained.

Electrically-Driven Grinding Tools.

As all high-class work is now finished by grinding, the British Thomson-Houston Co., Ltd., of Rugby, have devoted a large amount of attention to this operation, and the best means of performing it. As a result of the experience gained in their own workshops, they have recently introduced motor-driven emery wheels, which are adapted to any class of work, and are suitable for use on any



B.T.H. Portable Grinder, arranged for Centre Grinding on Lathe.

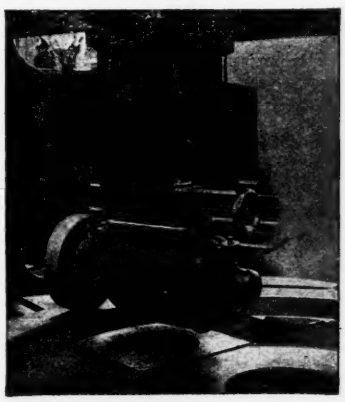
machine tool. The electric motors have been specially constructed to withstand hard usage, and to have a wide range of application. The frame of the motor is cylindrical in form, being a steel casting with inwardly projecting poles, fitted with removable malleable iron tips, which serve to hold the field spools in position. The latter are form wound, taped and insulated; the armature is of the slotted drum wound type, the core being made up of special quality insulated sheet steel laminations; the commutator segments are of hard-drawn copper, and are insulated from the

shell and each other by selected mica. The brushes are of carbon, and are pressed forward by fingers controlled by springs, so arranged as to maintain a constant pressure throughout the wear of the brush. The insulation of the armature and field coils is carried out by special processes.

The bearings are of gun-metal machined all over, the driving end bearing being split and double cone seated. Perfect adjustment is secured by means of a threaded bush which may be readily locked in position. Both bearings are dust-proof, and ample lubrication

B.T.H. Portable Grinder, arranged for Surface Grinding on Planing Machine.

is assured by means of special lubricators, precaution being taken to prevent access of grease to the interior of the motor. The motor is provided with a cross slide, the bed of which is cast solid with the frame. A fine feed is obtained by means of a left-hand worm, operated by a small hand-wheel, and gearing with a rack let into the bed of the slide. A removable tool post is secured in the



B.T.H. Portable Grinder, arranged for Flat Grinding on Vertical Boring Mill.

slide, which allows of the grinder being set with its axis at any angle. The slide is amply proportioned, and adds greatly to the utility of the grinder, permitting its use with equal facility on any machine tool, either with or without compound head or slide rest.

These grinders are supplied wound for use on circuits of 100 to 125, and 200 to 250 volts. Compactness, strength and durability are claimed as special features of the B.T.H. electric grinders.

Electrical Supplies Purchase Association.—The Einkaufs Vereinigung fur Elektrotechnische Bedarfs Artikel (Association for the Purchase of Electrical Supplies) is the title of a new concern which has been established as a company at Frankfort-on-Main. The company proposes, in conjunction with the existing Union of Electrical Installation Firms (Verband der Electrotechnischen Installations Firmen), to represent the interests of contractors and buy electrical apparatus, stores and supplies wholesale and distribute them among the members individually. The members of the board of directors are Aug. Berghausen, of Cologne, G. Montanus, of Schafer, and Montanus, of Frankfort, and Max. Wild, of Stuttgart. The board of supervision is composed of R. Seifert, of Hamburg, A. Kuckuk, of Dortmund, Felix Baumann, of Zwickau, and H. Oehmichen, of Carlsruhe.

NEW PATENTS APPLIED FOR.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

918,1A/05. "Improvements in electric light candle fittings." H. Hirst and J. H. Collings. March 1st. (Date applied for under Rule 5 of the Patents Rules, 1905, November 1st, 1905.) (Complete.)

4,649. "Improved coin-freed electric supply apparatus." J. M. Tourtel and W. H. Jones. February 26th.

4,653. "New or improved electro-magnetic door-opening apparatus." G. Smith and F. Bausche. February 26th. (Complete.)

4,657. "Improvements in or relating to apparatus for regulating the pressure of alternating current generators." Ganz & Co. Eisengiesserei und Machinen Fabriks A.G. February 26th. (Date applied for under Patents Act, 1901, May 4th, 1905, being date of application in Germany.) (Complete.)

4,677. "Improvements in or relating to electric arc lamps." A. Blondel. February 26th.

4,683. "Improvements in apparatus for the manufacture of wire, bars, and the like by electro-deposition." R. D. Sanders. February 26th.

4,684. "Improvements in the production of electrotypes." S. O. Cowper-Coles. February 26th.

4,691. "Improvements in wireless telephony or telegraphy." A. F. Collins. February 26th.

4,700. "Improvements relating to secondary batteries." H. W. Lake. (The Rhode Island Electromobile Co., United States.) February 26th. (Complete.)

4,702. "Automatic regulator for secondary batteries." L. Fiedler. February 26th.

4,710. "Improvements in and relating to the equipment of electrically-propelled vehicles or trains." W. B. Potter. (Date applied for under Patents Act, 1901, December 27th, 1905, being date of application in the United States.) February 26th. (Complete.)

4,711. "Improvements in and relating to the control of electric switches and operating mechanism therefor." J. S. Pevear. (Date applied for under Patents Acts, 1901, February 27th, 1905, being date of application in the United States.) February 26th. (Complete.)

4,716. "Improvements in electrolytic apparatus." F. McDonald. February 26th. (Complete.)

4,717. "Improvements in or relating to telephonic transmitters." Z. Wirt. February 26th.

4,720. "Improvements in electric switches and controlling mechanism therefor." J. S. Pevear. (Date applied for under Patents Act, 1901, February 27th, 1905, being date of application in United States.) February 27th. (Complete.)

4,724. "Improvements in apparatus for recording electrical measurements." J. Tatlock and J. D. Dennison. February 27th.

4,773. "Improvements in starting switches, rheostats or controllers for electric motors." A. Holmes, J. H. Holmes, L. W. Holmes, E. Holmes and G. J. Ralph. February 27th. (Complete.)

4,795. "Improvements relating to direct-current electric motors." La Societe Anonyme Westinghouse and R. Brun. (Date applied for under Patents Act, 1901, March 1st, 1905, being date of application in Germany.) February 27th. (Complete.)

4,808. "Improvements in or relating to holders for incandescent electric lamps." W. P. Brooks and A. D. White. February 27th. (Complete.)

4,813. "Means and apparatus for temporarily producing alternating currents in an electric circuit at one or more optional points of the circuit, and the application thereof to the working of printing telegraph apparatus." Siemens and Halske Actien Gesellschaft. (Date applied for under Patents Act, 1901, March 21st, 1905, being date of application in Germany.) February 27th. (Complete.)

4,815. "Improvements relating to electrical apparatus for transmitting and receiving signals." A. T. Dawson and G. T. Buckham. February 27th.

4,838. "Improvements in electric motors." H. W. Lake. (J. Smith, United States.) February 27th. (Complete.)

4,849. "Improvements in magnetic clutches, and a method and means of applying the same." H. W. Ravenshaw, V. G. Middleton and W. E. Townsend. February 27th.

4,850. "Improvements in fuse carriers." C. Beckingsale and The Reason Manufacturing Co., Ltd. February 27th. (Complete.)

4,862. "Improvements in electrical measuring instruments." W. Phillips and W. O. Smith. February 28th.

4,871. "Improvements in apparatus for compounding synchronous alternating current dynamo-electric machines." Bruce Peebles & Co., Ltd.) and J. L. La Cour. February 28th. (Complete.)

4,874. "Improvements in trolley pulleys or like collectors for electric traction." J. H. Shaw and O. France. February 28th.

4,880. "Improvements in time registering appliances for use in connection with fire alarm telegraphs and the like." A. C. Brown. February 28th.

4,891. "Method of multiple supply of continuous currents from an alternating current conductor." F. Neumann and E. Kepes. February 28th.

4,917. "Improvements in microphones." G. A. Nussbaum. February 28th.

4,925. "Improvements in and relating to the insulation of metal for electrical apparatus." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) February 28th.

4,926. "Improvements in and relating to electric motor control systems." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) February 28th.

4,929. "Improvements relating to rheostats." J. Ogilvy and C. W. Dawson. February 28th.

4,930. "Improvements in or relating to speed regulating and steering apparatus for electrically-propelled road vehicles." J. Ogilvy and C. W. Dawson. February 28th.

4,931. "An electric horn." L. Chalas, E. Requillart and C. Contal. (Date applied for under Patents Act, 1901, March 3rd, 1905, being date of application in France.) February 28th. (Complete.)

4,936. "Improvements in electric motors." H. M. Hobart. February 28th.

4,951. "Improvements in or relating to electricity meters." O. Paulet. Date applied for under Patents Act, 1901, March 1st, 1905, being date of application in Germany.) February 28th. (Complete.)

4,970. "Improvements in joint boxes and the like for telegraphic and other electrical cables." D. Bould. March 1st.

5,002. "An improved method of and means for coating and impregnating piece goods with waterproof and insulating material." E. Rosenberg. March 1st.

5,003. "Improvements in controlling devices for electric motors applicable to the motors of elevators or lifts and the like." Otis Elevator Co., Ltd. (Otis Elevator Co., United States.) March 1st. (Complete.)

5,028. "Improvements in terminals or binding posts for electrical connections." G. F. Guyon. March 1st.

5,037. "Improvements in synchronous alternating current generators." F. W. Howorth. (Maschinenfabrik Oerlikon, Switzerland.) March 1st. (Complete.)

5,047. "Improvements in apparatus for electro-therapeutic treatment." M. C. A. C. Kroeger. March 1st. (Complete.)

5,082. "Improvements in magnetic clutches for conveying rotary motion." W. O. Horsnaill. March 2nd.

5,088. "Improvements in supports for conductors for electric railways." P. J. Pringle. March 2nd.

5,089. "Improvements in trolley wheels and similar collecting devices for electric railways." P. J. Pringle. March 2nd.

5,092. "An improvement in electric lamp heating apparatus." A. B. Holmes. March 2nd. (Complete.)

5,093. "An improvement connected with telephonic and similar instruments." W. D. Shaw-Browne and S. A. Williams. March 2nd. (Complete.)

5,111. "Improvements in or relating to electric lamps." A. J. Barron and R. A. Barron. March 2nd.

5,129. "Improvements in the process of manufacturing light emitting bodies for electric glow lamps and of connecting them with the supply conductors." H. Kuzel. March 2nd. (Complete.)

5,136. "Improvements in single-phase dynamo-electric machines." F. Creedy. March 2nd.

5,153. "Improved means for regulating asynchronous electric motors." The Elektrizitats Act.-Ges. vorm W. Lahmeyer & Co. (Date applied for under Patents Act, 1901, March 18th, 1905, being date of application in Germany.) March 2nd. (Complete.)

5,154. "Improvements in magnets for alternating currents." The Elektrizitats Act. Ges. vorm W. Lahmeyer & Co.) (Date applied for under Patents Act, 1901, May 31st, 1905, being date of application in Germany.) March 2nd. (Complete.)

5,160. "Electrical generator." M. Schwartz. (Date applied for under Patents Act, 1901, March 7th, 1905, being date of application in United States.) March 2nd. (Complete.)

5,166. "Improvements in holders for commutator brushes." The Morgan Crucible Co., Ltd., and C. W. Speirs. March 2nd.

5,167. "Improvements in pneumatic holders for commutator brushes." The Morgan Crucible Co., Ltd., and C. W. Speirs. March 2nd.

5,168. "Improvements in or connected with systems of electric lighting." H. Leitner. March 2nd.

5,170. "Improvements in electric fusible cut-outs." O. L. Peard. March 2nd.

5,171. "Improvements in electric fusible cut-outs." O. L. Peard. March 2nd.

5,176. "Means for absorbing the vibrations in steam, gas or electric engines and motors (stationary or locomotive), cars, trucks, wagons, carriages, carts, and other vehicles either to supersede resilient tires or supplement them." E. Kingscott. March 3rd.

5,202. "An improved electrical time signalling timepiece or apparatus." E. Eatwell. March 3rd.

5,221. "Improvements in electrical tumbler switches." G. Sperryn and W. H. Wood. March 3rd.

5,258. "Improvements in or relating to wireless telegraphy." L. de Forest. March 3rd. (Complete.)

5,261. "Improvements in and relating to dynamo electric machines." The British Thomson-Houston Co., Ltd., and B. Hopps. March 3rd.

5,262. "Improvements in and relating to the suspension of the motors in electrically-propelled vehicles." The British Thomson-Houston Co., Ltd., and B. Hopps. March 3rd.

5,263. "Improvements in and relating to the control of electrically-propelled vehicles." The British Thomson-Houston Co., Ltd., and B. Hopps. March 3rd.

5,268. "An improved insulating device for underground electric conductors." A. Koreck and B. Pikal. March 3rd.

20,175A/05. "Improvements relating to the manufacture of incandescing bodies for electric incandescent lamps." A. Just, F. Hanaman, H. Landesberger, I. Salzmann and Vereinigte Electricitats Act.-Ges. (Date applied for under for under Rule 5 of the Patents Rules, 1905, October 5th, 1905.) March 16th.

5,912. "Improvements in electric arc lamps." J. W. Ewart, S. Davison and M. Stuart. March 12th.

5,930. "A combined rail, slot and conduit and electrical system for electric tramways and railways." N. Brewer and J. Foster. March 12th.

5,945. "Improvements in troughs for electric cables and the manufacture thereof." J. Stratton, E. A. Claremont, C. J. Beaver and A. E. Tanner. March 12th.

5,946. "Improvements in the manufacture of troughs for electric cables." J. Stratton, E. A. Claremont, C. J. Beaver and A. E. Tanner. March 12th.

5,947. "Improvements in troughs for electric cables and the manufacture thereof." J. Stratton, E. A. Claremont, C. J. Beaver and A. E. Tanner. March 12th.

5,952. "Improvements in or relating to electro-magnetic switches and other electro-magnetic mechanisms." M. B. Field and Ferranti, Ltd. March 12th.

5,964. "Improvements relating to regulating and other electrical resistances." E. N. Bray and Bray, Markham & Reiss, Ltd. March 12th.

6,006. "Improvements in and relating to electric switches." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) March 12th.

6,008. "A medicated electric battery adhesive plaster." L. B. Morres. March 12th.

6,010. "Improved conduit for electric conductors." A. E. Woodhouse. March 12th.

6,020. "Improvements in and relating to the control of electric motors." A. Berlin. March 12th.

6,024. "New method of using a dynamo and motor instead of a clutch and change speed gears on self-propelled vehicles." J. G. P. Thomas and C. R. McGowan. March 13th.

6,045. "Improvements in trolley heads for electric tramcars." F. W. Blaker. March 13th.

6,061. "Surgical lamp adaptor with rheostat." F. N. Davidson. March 13th.

6,079. "A new or improved automatic regulating device for pneumatically-controlled collectors supplying electric current to trains or road cars." R. Vontobel. (Date applied for under Patents Act, 1901, March 14th, 1905, being date of application in Switzerland.) March 13th. (Complete.)

6,088. "Improvements in and relating to electrodes." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) March 13th.

6,089. "Improvements in and relating to resistance material." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) March 13th.

6,099. "Improvements in or relating to devices for detecting faults in the insulation of electric conductors." A. J. Boult. (S. W. Wardwell, United States.) March 13th. (Complete.)

6,105. "Improvements in electric incandescent lamps." J. G. Gibson. March 13th.

6,155. "Improvements in electric circuit closing devices." W. G. Collins. March 14th.

6,180. "An improved anti-vibration device for electric meters and the like." L. Robinson & Co., Ltd., and L. I. Robinson. March 14th. (Complete.)

6,193. "Improvements in resistance units." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) March 14th.

6,194. "Improvements in and relating to dynamo-electric machines." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) March 14th.

6,195. "Improvements in and relating to dynamo-electric machines." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) March 14th.

6,200. "Improvements in connection with lead-sheathed cables." G. G. M. Hardingham. (Felten & Guilleaume Lahmeyerwerke A.-Ges., Germany.) March 14th.

6,201. "Improvements in separators for electric batteries." W. P. Perry. March 14th.

6,216. "A luminous electric bell indicator." Societe Ch. Milde fils et Cie. (Date applied for under Patents Act, 1901, March 14th, 1905, being date of application in France.) March 14th. (Complete.)

6,217. "Improved methods of signalling in wireless telegraphy." V. Poulsen. March 14th. (Complete.)

6,218. "Improvements in means for starting compensated monophase commutator motors." Elektrizitats-Actien-Gesellschaft vorm W. Lahmeyer and Co. (Date applied for under Patents Act, 1901, March 16th, 1905, being date of application in Germany.) March 14th. (Complete.)

6,219. "Improvements in transmitters for electro-magnetic waves." J. Sahulka. March 14th. (Complete.)

6,223. "Improvements in dynamo-electric machines." L. J. Hunt and The Sandycroft Foundry Co., Ltd. March 14th.

6,224. "Improvements in alternating current dynamo-electric machines." L. J. Hunt and The Sandycroft Foundry Co., Ltd. March 14th.

6,262. "Improved method of electrically operating hydraulic apparatus." E. M. T. Boddam. March 15th.

6,283. "Improvements in or relating to electric furnaces." P. R. Kuehnrich. March 15th.

6,299. "Improvements in electric arc lamps of the flaming arc type." J. Brockie. March 15th.

6,300. "Improvements in the regulation of enclosed arc lamps." J. Brockie. March 15th.

6,316. "Improvements in and relating to electrical transformers." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) March 15th.

6,317. "Improvements in insulators." E. J. Foreman. (Date applied for under Patents Act, 1901, March 16th, 1905, being date of application in United States.) March 15th. (Complete.)

6,344. "Improvements in carriages for conveying drums of electric cables and such like." W. A. Turner. March 16th.

6,412. "Improvements in electrical condensers." G. Marconi and Marconi's Wireless Telegraph Co., Ltd. March 16th.

6,423. "Improvements in electric sparking plugs." E. Canedy. (Date applied for under Patents Act, 1901, March 16th, 1905, being date of application in United States.) March 16th. (Complete.)

6,426. "Improvements in or relating to the treatment of magnetic materials." R. A. Hadfield. March 16th. (Complete.)

6,441. "Improvements connected with the electrical ignition of gas lamps." Electrical Improvements, Ltd., and A. E. Hacking. March 17th.

6,446. "Improvements in supports and controlling devices for flexible electric pendants and the like." G. Percival. March 17th.

6,454. "Improvements in or relating to apparatus for measuring and recording the flow of liquids or gases and for measuring and recording mechanical and electrical quantities." J. E. Lea. March 17th.

6,476. "Improvements in and connected with electric light and bell fittings." C. F. Wood. March 17th.

6,477. "Improvements in or relating to apparatus for winding wire and the like, especially applicable for use in the manufacture of electrical machinery." H. L. Hollington. March 17th.

6,490. "An automatic electric locking device for preventing the opening of railway carriage doors while the train is in motion." J. W. Harris. March 17th.

6,496. "Improvements in and relating to electric circuit-breakers." J. Roothaan and Ferranti, Ltd. March 17th.

6,499. "Improvements in Morse and like code-operated machines." J. P. L. Donlevy. March 17th.

6,500. "Microphonograph." E. Ducretet. March 17th. (Complete.)

6,510. "Improvements in electric arc lamps." J. Brockie. March 17th.

6,515. "Improvements in and relating to arc light carbons." A. Kufferath and The Firm of Dr. L. C. Marquart. March 17th. (Complete.)

ELECTRICAL PATENTS EXPIRING IN 1906.

We are informed by W. P. Thompson & Co. that about 600 complete applications for electrical patents were filed in the year 1892. Only 37 of the patents granted on these applications have been maintained for their full term, viz., 14 years, and being of considerable value, we give short abstracts of them below:—

(Continued from page 496.)

7,029. "Electric conductors." G. G. M. Hardingham. (Felten & Guilleaume, Germany.) April 12th, 1892. Conductors are laid on a strip of insulating material, such as paper, which is then twisted into a spiral, the conductors lying in the hollows. Wings of the insulating material may be folded round to enclose the spirals. Conductors may be laid in flexible insulating material of star section. Cables may be formed by grouping the above described pairs, or by arranging star cables concentrically. Such cables may be armoured or not as required.

9,631. "Ozone." E. Andreoli. May 20th, 1892. Refers to Specification No. 17,426 A.D. 1891, and relates to improvements in the ozonisers described therein, various forms of which are here described, suitable for bleaching fibres or tissues, treating oils or other liquids, ozonising organic or inorganic substances, or applying ozone to therapeutic or hygienic purposes. Each ozoniser is composed of double or compound metallic point-bearing or toothed plates forming one electrode, and enamelled metal plates or cylinders, or plain plates with di-electric plates on one or both sides, forming the other electrode.

10,430. "Insulating sheets." R. Wood. June 1st, 1892. Insulating sheets are formed of flakes of mica cemented by shellac on to tissue paper (Japanese) or thin fabric such as Indian lawn or silk. Alternate layers of fabric and mica may be employed when a thick sheet is wanted.

10,524. "Electric insulation." A. D. S. Dyer, U.S.A. June 2nd, 1892. Insulating material in the form of sheets applicable for insulating electric conductors, and commutator sections, armatures and field magnets of dynamos. Flakes of mica are cemented together by means of copal and shellac, and are built up into layers. The mass is afterwards heated and pressed to consolidate and remove the superficial varnish. Larger flakes of mica are cemented on both surfaces of the sheets.

10,818. "Conduit for electric conductor." C. Bollé. (C. W. Jifferson, U.S.A.) June 7th, 1892. A conduit for electric conductors is formed by building up sheets of mica by means of cement, such as shellac, and forming the sheets into a tube round a hollow core capable of being heated and cooled. The sheets may be built together to form a tube, or may be cut into strips and wound spirally on the core.

11,526. "Electric Cable." G. G. M. Hardingham. (Felten & Guilleaume, Germany.) June 20th, 1892. An electric cable is constructed with a central grooved core of insulating material. The conductors are laid in these grooves and the whole are enclosed in a layer of paper; around this is a lead sheathing which supports gutta-percha coverings; around this again is a soft coating of hemp, &c. This is finally enclosed by an armouring of interlocking wires, which is covered with a serving of tarred hemp. The construction of the cable may be varied by having a different number of conductors or combining two or more of the inner cables in one external sheathing.

13,920. "Electromotors." W. H. Knight and W. B. Potter, both of U.S.A. July 30th, 1892. Regulating power and speed of electromotors. Two separate motors are employed to drive the mechanism, and the changes are effected by placing them in series parallel, &c. Whilst the changes are being made one of the motors is short-circuited.

(To be continued.)

Keep for Reference.

The British Westinghouse Electric and Mfg. Co., Ltd.

LONDON AND MANCHESTER.

"Multiphase, London." 3261 and 2476 Gerrard. | Telegraphic Addresses and Telephone Numbers: | "Westinghouse, Manchester." 5222 and 4109, Central, Manchester.

Codes used: Westinghouse and Lieber.

Advertising Bulletin No. 7. March, 1906.

Steam Turbo-Generators.

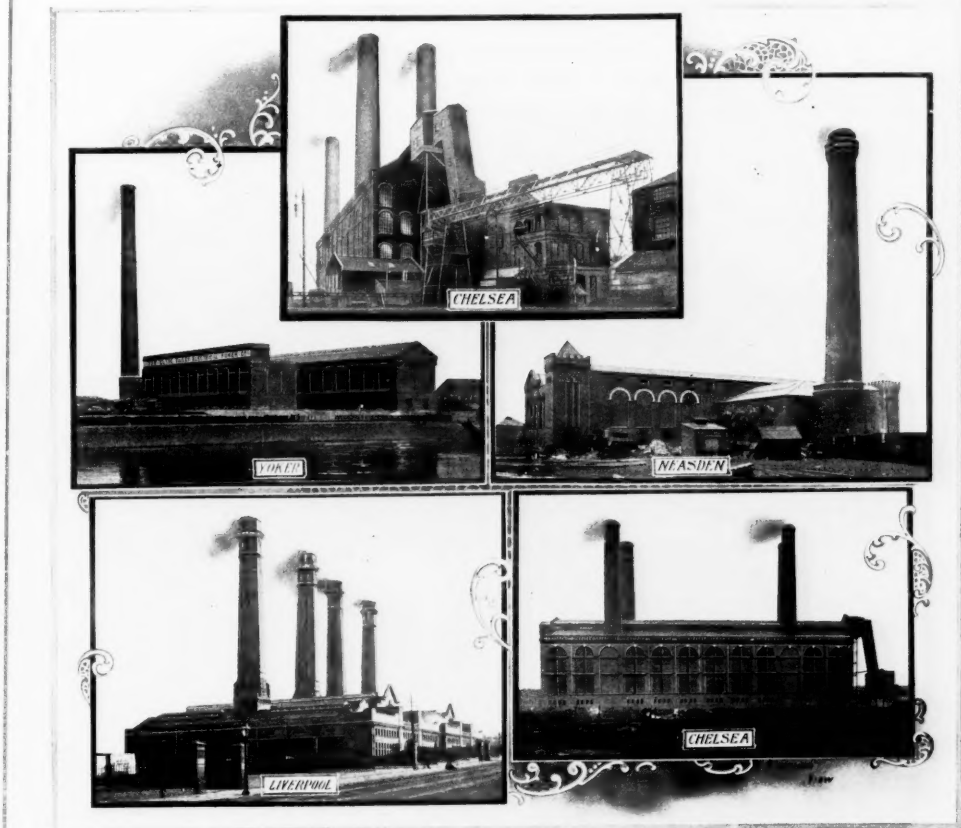


Fig. 1.—Views of some of the Power Stations where Westinghouse Steam Turbo-Generators have been installed.

Keep for Reference.

(To be continued.)

The British Westinghouse Electric & Mfg. Co., Ltd.

The great future before the Steam Turbine as a prime mover is fully evidenced by the increasing number of such installations that are put down year after year. The advantages possessed by the steam turbine as compared with the reciprocating engine have been completely demonstrated so many times, and in so many ways, that it is only necessary to give bare mention to them here.

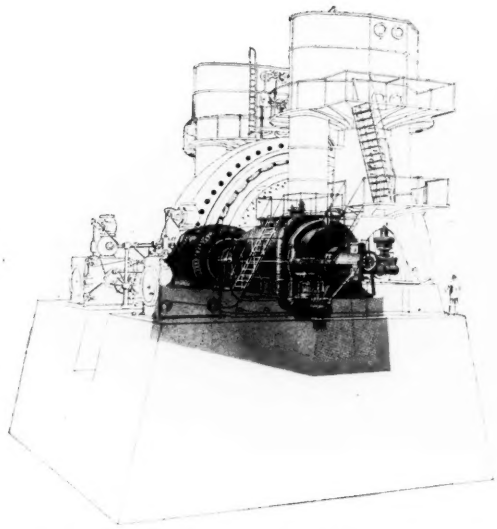


Fig. 2.—Comparison of Space occupied by Reciprocating Engine and Turbine Electric Generating Sets respectively.

(1.) Saving in Floor Space, Cost of Foundations, and Head Room. These advantages may be seen in many Electric Generating Stations of to-day; and Fig. 2 gives a comparison which speaks for itself; each of the sets there shown being of 5000-KW. capacity.

(2.) Efficiency. Many tests have already been published which conclusively demonstrate that the Steam Turbine can hold its own as regards efficiency with the best steam engine of any other type.

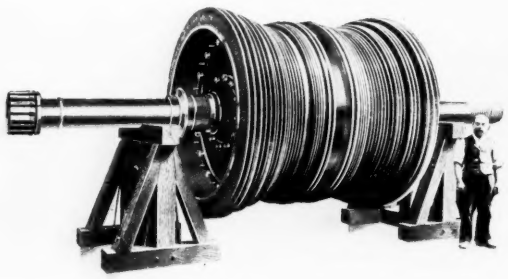


Fig. 3. "Spindle" of 5500 KW. Turbine.

(3.) Use of Superheated Steam. Tests have shown that considerably better efficiency can be obtained, both with turbine and reciprocating engines, by the use of superheat. The construction of a Steam Turbine is such that no internal lubrication is required, and it is, therefore, the ideal machine for use with high-temperature steam.

(4.) Maintenance. As the Steam Turbine is so compact and so easily operated, and as all main lubrication is automatic, the maintenance and upkeep station costs are reduced to a minimum.

(5). Parallel running of Alternators. As the turning movement is as nearly as possible absolutely constant, owing to the absence of reciprocating parts, the Turbo-Alternator is necessarily an ideal machine for parallel operation.

Fig. 4.—Stator of 3500 KW. 3-Phase Generator.

The British Westinghouse Co. have installed, or have in course of construction, Steam Turbines and Generators aggregating some 180,000 Brake Horse-Power.

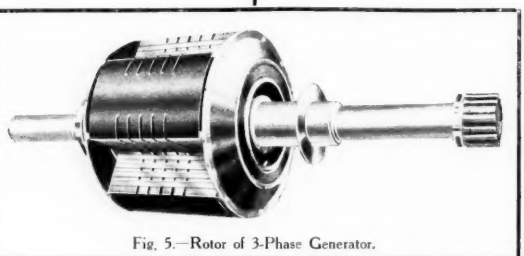


Fig. 5.—Rotor of 3-Phase Generator.

Among the installations equipped with this class of engine may be mentioned the Chelsea Power House, the largest electric generating station in the Kingdom; and the important power stations at Neasden, Clyde Valley, Liverpool, Brighton, etc. The

The British Westinghouse Electric & Mfg. Co., Ltd.

number and capacity of these stations clearly proves that the Westinghouse Steam Turbine holds the foremost position amongst prime movers of this class. Exterior views of some of the stations are given in Fig. 1.

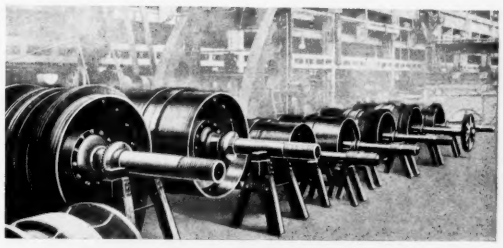


Fig. 6.—Row of Turbine "Spindles" at the Westinghouse Works. Manchester.

Considerable study has been given to the design and construction of steam-turbine machinery during the last twenty years. The British Westinghouse Company (besides being licencees of Messrs. C. A. Parsons & Co.) has especially appreciated the fact that the mechanical design is perhaps the most important factor, in view of the ever-increasing demand for larger units. With the British Westinghouse Turbine, as now constructed, there is no limit to the size of the unit. The materials used are of the finest possible quality throughout, so that balancing troubles are reduced to a minimum, the result being a machine that can be guaranteed to run with absolute smoothness and without appreciable vibration.

The British Westinghouse Company will be pleased to furnish further particulars of their Steam-Turbine work at any time, and also to give guarantees for the efficiency and prompt delivery of machines ordered from them.

Following is a list of plant that is already or will shortly be installed in the various Generating Stations mentioned.

Chelsea Power Station. Eight 5500 KW.

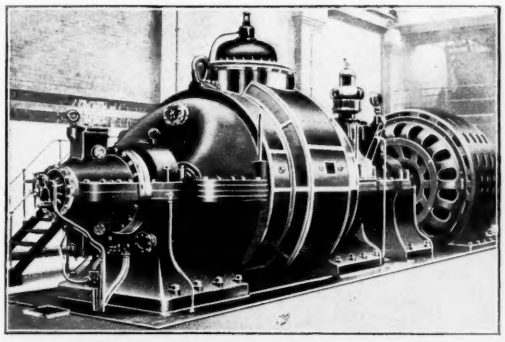


Fig. 7.—Complete Turbo-Generator (Neasden).

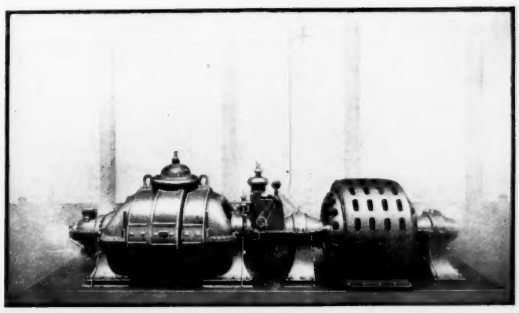


Fig. 8.—One of the Turbo-Generators at Chelsea.

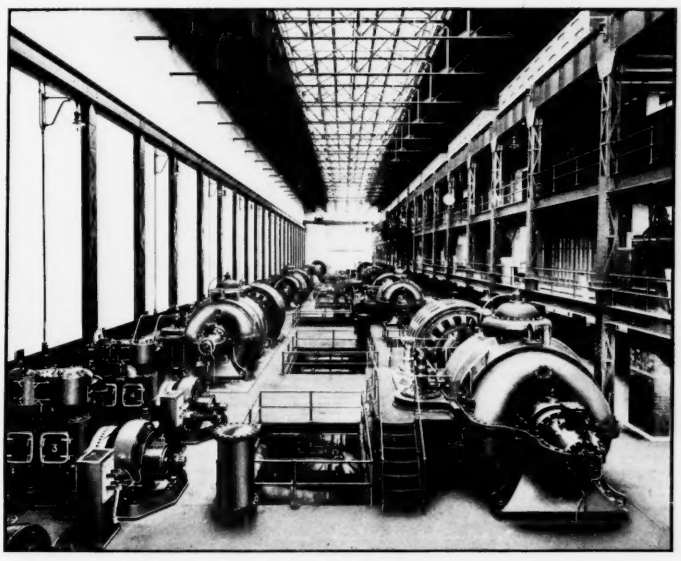


Fig. 9.—Chelsea Power Station (Interior).

Turbines coupled direct to Alternators for generating 3-phase current at 11000 volts. The speed of the sets is 1000 R.P.M.

Neasden Power Station. Four 3500-KW. Turbines coupled direct to Alternators for generating 3-phase current at 11000 volts. The speed of the sets is 1000 R.P.M.

The British Westinghouse Electric & Mfg. Co., Ltd.

Clyde Valley Electrical Power Company.

Yoker Station. Two 2000-KW. Turbines coupled direct to Alternators for generating 3-phase current at 11,000 volts. Speed:—1500 R.P.M.

Motherwell Station. Two 2000-KW. Turbines coupled direct to Alternators for generating 3-phase current at 11,000 volts. Speed:—1500 R.P.M.

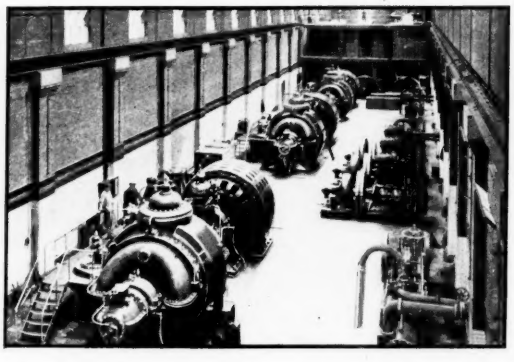


Fig. 10.—Neasden Power Station. (Portion of Interior.)

Liverpool Corporation. Two 2000-KW. and two 1600-KW. Turbines coupled direct to Alternators for generating 3-phase current at 6600 volts. Speed:—1500 R.P.M.

Savoy Hotel, London. Two 200-KW. and two 100-KW. non-condensing Turbines coupled direct to Direct-Current Generators. Voltage:—110. Speed:—2000 and 2600 R.P.M. respectively.

Brighton Corporation. Three 1800-KW. Turbines coupled direct to Alternators for generating 3-phase current at 8000 volts. These sets run at 1500 R.P.M.

Birkmyre Bros., Jute Mills, India. Two 1500-KW. Turbines coupled direct to Alternators for generating 3-phase current at 440 volts. Speed:—1500 R.P.M.

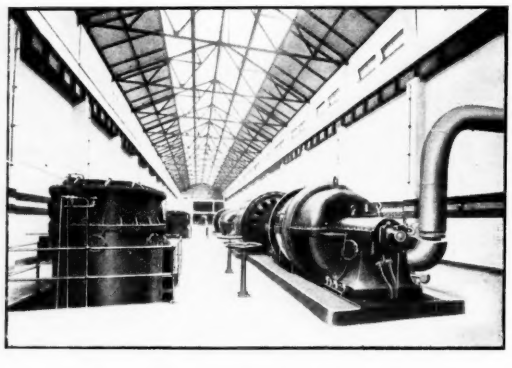


Fig. 11.—Yoker Power Station. (Clyde Valley.)

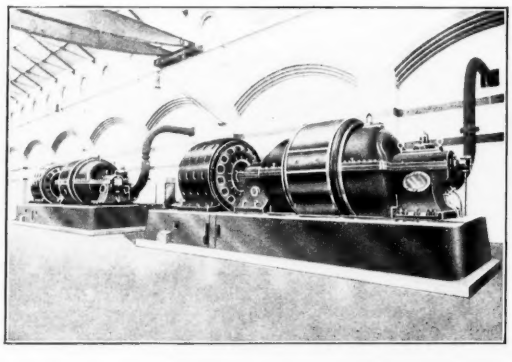


Fig. 12.—Lister Drive Power Station, Liverpool. (Portion of Interior.)

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